33-AC-1

DEERFIELD RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS
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DEERFIELD RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

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Department of Environmental Protection
Division of Watershed Management

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Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, Massachusetts

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<u>Local</u>

- Deerfield River Watershed Association (DRWA)

<u>State</u>

- Massachusetts Executive Office of Environmental Affairs (EOEA), Deerfield Watershed Team
- Massachusetts Department of Environmental Protection (MA DEP)
  - Bureau of Resource Protection
  - Bureau of Strategic Policy and Technology's Wall Experiment Station
  - Bureau of Waste Prevention
  - Bureau of Waste Site Cleanup
- Massachusetts Department of Public Health (MA DPH)
- Massachusetts Department of Fish and Game (MA DFG) (Formerly Department of Fisheries, Wildlife, and Environmental Law Enforcement, MA DFWELE)
  - Division of Fisheries and Wildlife (MassWildlife)
  - Riverways Program
- Massachusetts Department of Conservation and Recreation (MA DCR) (Formerly Department of Environmental Management, MA DEM)
- Vermont Department of Environmental Conservation (VT DEC)

<u>Federal</u>

- United States Environmental Protection Agency (EPA)
- United States Army Corps of Engineers (ACOE)
- United States Geological Survey (USGS)
  - Water Resources Division

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Cover photo: Tannery Brook in Savoy, Massachusetts
Photo credit: Alan Wynn, EOEA

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cfs	cubic feet per second
cfu	colony forming unit
ft^3	cubic feet
gpm	gallons per minute
km^2	square kilometers
KW	kilowatts
MGD	million gallons per day
mi^2	square miles
µg/kg	microgram per kilogram
µS/cm	microsiemans per centimeter
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL	milliliter
msl	mean sea level
ng	nanograms
NTU	nephelometric turbidity units
ppb	parts per billion
ppm	parts per million
SU	standard units
TEQ/kg	toxic equivalents per kilogram

LIST OF ACRONYMS

7Q10	seven day, ten year low flow
ACEC	Areas of Critical Environmental Concern
ACOE	Army Corps of Engineers (United States)
ADB	assessment database
AKA	also known as
BMP	best management practice
BPJ	best professional judgment
BRP	Bureau of Resource Protection
CMR	Code of Massachusetts Regulations
CNOEC	chronic no observed effect concentration
CRWA	Connecticut River Watershed Association
CT DEP	Connecticut Department of Environmental Protection
CVP	Certified Vernal Pool
CWA	Clean Water Act
DDT	dichlorodiphenyltrichloroethane
DAR	Department of Agricultural Resources
DFA	Department of Food and Agriculture
DMF	Division of Marine Fisheries
DMR	discharge monito ring report
DO	dissolved oxygen
DPW	Department of Public Works
DRWA	Deerfield River Watershed Association
DWM	Division of Watershed Management
DWP	Drinking Water Program
EOEA	Executive Office of Environmental Affairs
EPA	United States Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ESS	Environmental Science Services
FERC	Federal Energy Regulatory Commission
FPOM	fine particulate organic matter
GCC	Greenfield Community College
IWPA	Interim Wellhead Protection Act
LC_{50}	lethal concentration to 50% of the test organisms
L-EL	low effect level
MA DCR	Massachusetts Department of Conservation and Recreation
MA DEM	Massachusetts Department of Environmental Management (now the Department of Conservation and Recreation)
MA DEP	Massachusetts Department of Environmental Protection
MA DFG	Massachusetts Department of Fish and Game
MA DFWELE	Department of Fisheries, Wildlife and Environmental Law Enforcement (now the Department of Fish and Game)
MA DPH	Massachusetts Department of Public Health
MassGIS	Massachusetts Geographic Information System
MassWildlife	Massachusetts Division of Fisheries and Wildlife
MCL	Maximum Contaminant Level
MDL	Minimum Detection Limit
MPN	Most Probable Number
NAS/NAE	National Academy of Sciences/National Academy of Engineers
NAWQA	National Water-Quality Assessment
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source pollution
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
ORV	off road vehicle
ORW	Outstanding Resource Water
PAH	Polyaromatic Hydrocarbons
PALIS	Pond and Lake Information System
PCB	polychlorinated biphenyls
PGE-NEG	Pacific Gas and Electric – Northeast Generating Group
PWS	public water supply
QAPP	quality assurance project plan
QA/QC	quality assurance/ quality control
RBP	rapid bioassessment protocol
SARIS	Stream and River Inventory System
SDWA	Safe Drinking Water Act
S-EL	severe effect level
SMART	Strategic Monitoring and Assessment for River Basin Teams
SWAP	Source Water Assessment Program
SWPPP	Stormwater pollution prevention plan
SWQS	Surface Water Quality Standards
TMDL	total maximum daily load
TNTC	too numerous to count
TOXTD	MA DEP DWM Toxicity Testing Database
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRC	total residual chlorine
UMass	University of Massachusetts
USGS	United States Geological Survey
VOC	volatile organic compounds
VS	volatile solids
VT DEC	Vermont Department of Environmental Conservation
WBID	waterbody identification code
WBS	waterbody system database
WERO	Western Regional Office
WMA	Water Management Act
WPCF	water pollution control facility
WPCP	water pollution control plant
WQC	water quality criteria
WTF	water treatment facility
WWTF	wastewater treatment facility
WWTP	wastewater treatment plant
YAEC	Yankee Atomic Electric Company
YNPS	Yankee Nuclear Power Station

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EXECUTIVE SUMMARY
DEERFIELD RIVER WATERSHED
2000 WATER QUALITY ASSESSMENT REPORT

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which surface waters in the Commonwealth shall be protected. The assessment of current water quality conditions is a key step in the successful implementation of the Watershed Approach. This critical phase provides an assessment of whether or not the designated uses are supported, impaired, or not assessed, as well as basic information needed to focus resource protection and remediation activities later in the watershed management planning process.

This assessment report presents a summary of current water quality data/information in the Deerfield River Watershed used to assess the status of the designated uses as defined in the SWQS. The designated uses, where applicable, include: *Aquatic Life, Fish Consumption, Drinking Water, Primary* and *Secondary Contact Recreation* and *Aesthetics*. Each use within a given segment is individually assessed as ***support*** or ***impaired***. When too little current data/information exist or no reliable data are available the use is ***not assessed***. However, if there is some indication of water quality impairment, which is not "naturally occurring", the use is identified with an "Alert Status". It is important to note that not all waters are assessed. Many small and/or unnamed rivers and lakes are currently ***unassessed***; the status of their designated uses has never been reported to the EPA in the Commonwealth's Summary of Water Quality Report (305(b) Report) nor is information on these waters maintained in the Assessment Database (ADB).

The Deerfield River watershed occupies a total of 665 mi^2 (1738 km^2). Approximately half of the watershed is in southern Vermont (318 mi^2) and half lies in the Franklin and Berkshire counties of western Massachusetts (347mi^2). Overall, landuse within this predominately rural watershed is classified as 81% forested, 13% agriculture/open land, 4% urban, and 2% water. The southern portion of the watershed contains most of the population and the land use, although still heavily forested, contains more of a mix of agricultural, residential, and industrial uses. The largest and only city in the watershed is Greenfield, MA (population 18,168). It contains almost half the population of the entire watershed (US Census Bureau 2003). In the northern and western areas of the watershed the topography is mountainous and the river's profile is steep, which makes it attractive for hydroelectric power generation. Along the mainstem there are nine licensed hydroelectric stations (seven in MA, including a pumped storage facility) and associated dams, that effectively control the flow of the river. Water released from the dams affects the entire range of stream flow and causes multiple daily stream stage fluctuations.

There are 149 named rivers, streams, brooks or creeks (the term "rivers" will hereafter be used to include all) totaling 344.8 river miles within the Massachusetts portion of the Deerfield River Watershed (Halliwell *et al*. 1982). There are 24 rivers (179.4 miles) representing 9% of the total named river miles in the Massachusetts portion of the Deerfield River Watershed assessed in this report. These include: Bear River, Bozrah Brook, Chickley River, Clark Brook, Clesson Brook, Cold River, Davis Mine Brook, Deerfield River, Dragon Brook, Drakes Brook, East Branch of the North River, Foundry Brook, Green River, Hinsdale Brook, Mill Brook, North River, Pelham Brook, Pumpkin Hollow Brook, Shingle Brook, Smith Brook, South River, Taylor Brook, Tisdale Brook and the West Branch of the North River. The remaining rivers are small and/or unnamed and currently unassessed.

This report also presents information on 22 of the 24 named lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) in the Deerfield River Watershed. The 22 lakes listed in this report represent over 99% of the total lake acreage (560.6 of the 562 acres) in the Massachusetts portion of the Deerfield River Watershed. A total of 29 lakes, ponds or impoundments at one time were identified and assigned PALIS code numbers in the Deerfield River Watershed (Ackerman 1989 and MA DEP 2001a). However, three lakes from this PALIS list (Greenfield Reservoir in Leyden, Little Mohawk Pond in Shelburne, and Schneck Brook Pond in Conway) have not been included in this report because they no longer exist as lakes (dam removed and/or filled in with aquatic vegetation). Another lake (Paddy Hill Pond, Ashfield) on the Deerfield Watershed PALIS list was found to be located in the Westfield Watershed. Two others (South River Impoundment in Conway and Lower Reservoir in Rowe/Florida) are assessed as part of the river segments in which they exist as run-of-the-river impoundments and are not included in the lakes assessment to avoid redundancy.

AQUATIC LIFE USE

The *Aquatic Life Use* is supported when suitable habitat (including water quality) is available for sustaining a native, naturally diverse, community of aquatic flora and fauna. Impairment of the *Aquatic Life Use* may result from anthropogenic stressors that include point and/or nonpoint source(s) of pollution and/or hydrologic modification.

Aquatic Life Use Summary – Rivers (Figure 1)

As illustrated in Figure 1, eighty-six percent (86%) of the river miles in the Deerfield River Watershed reviewed in this report were assessed (supported or impaired) for the *Aquatic Life Use*. A total of 153.4 river miles, representing 15 tributaries to and the entire length of the Deerfield River, are assessed as supporting the *Aquatic Life Use*. The *Aquatic Life Use* is assessed as impaired in the lower 1.7 miles of Davis Mine Brook. This impairment represents only 1% of the river miles reviewed in this report. The primary cause of impairment is pH from acid mine drainage. The remaining seven named rivers in this report and the upper portions of Davis Mine Brook and the South River totaling 24.3 miles (14% of the river miles in the watershed) are currently not assessed for the *Aquatic Life Use*.

DEERFIELD RIVER WATERSHED:
***Aquatic Life Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 153.4 miles (86%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 24.3 miles (14%)**

***Aquatic Life Use* assessment for lakes**
(Total area reviewed in report is 562 acres.)

- **Not Assessed – 562 (100%)**

Aquatic Life Use Summary – Lakes (Figure 1)

Few lakes in the Deerfield River Watershed have recently been surveyed for variables used to assess the status of the *Aquatic Life Use* (i.e., DO, pH, nutrients, macrophytes and plankton/chlorophyll *a*). Because of the lack of these types of data none of the lakes in the Deerfield River Watershed are assessed for the *Aquatic Life Use*.

FISH CONSUMPTION USE

The *Fish Consumption Use* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions (as opposed to whole fish - see description of *Aquatic Life Use* guidance) of fish, other aquatic life or wildlife for human consumption. The assessment of the *Fish Consumption Use* is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, MADPH, Bureau of Environmental Health Assessment (MADPH 2002a). The MADPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species poses a health risk for human consumption. Hence, the *Fish Consumption Use* is assessed as impaired in these waters. In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001). Because of these statewide advisories no waters can be assessed as support for the *Fish Consumption Use.* These waters default to "not assessed". The statewide advisories read as follows.

> The MA DPH "is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)." Additionally, MA DPH "is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)." MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

Fish Consumption Use Summary - Rivers (Figure 2)

No site-specific fish consumption advisories exist for river segments in the Deerfield River Watershed, therefore all river segments default to Not Assessed for the *Fish Consumption Use* because of the statewide advisory.

DEERFIELD RIVER WATERSHED:
***Fish Consumption Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)
- **Not Assessed – 179.4 miles (100%)**

***Fish Consumption Use* assessment for lakes**
(Total area reviewed in report is 562 acres.)
- **Impaired – 132 acres (23%)**
- **Not Assessed – 430 acres (77%)**

Fish Consumption Use Summary – Lakes (Figure 2)
Because of health concerns associated with exposure to mercury, MA DPH issued fish consumption advisories for Sherman Reservoir and Plainfield Pond (MA DPH 1996 and MA DPH 2002a). The advisories recommend the following.

Sherman Reservoir (Rowe):
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat fish from Sherman Reservoir.
2. The general public should not consume any yellow perch from Sherman Reservoir, and
3. the general public should limit consumption of non-affected fish species from Sherman Reservoir to two meals per month."

Plainfield Pond (Plainfield):
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass from this waterbody, and
2. the general public should limit consumption of largemouth bass from this waterbody."

Consequently, the *Fish Consumption Use* is impaired for Sherman Reservoir (72 acres in MA out of a total of 162 acres representing both MA and VT acreage) and Plainfield Pond (60 acres). These two lakes represent 23% of the lake acreage reviewed in the Deerfield River Watershed. It should be noted that Sherman Reservoir in Vermont is listed as partially supporting the *Fish Consumption Use* due to elevated tissue mercury concentrations (VT DEC 2003). The remaining lakes default to Not Assessed for the *Fish Consumption Use* because of the statewide advisory. Sources of mercury in this area are currently unknown, although atmospheric deposition is suspected.

DRINKING WATER USE
The term *Drinking Water Use* has been used to indicate sources of public drinking water. While this use is not assessed in this report, the state provides general guidance on drinking water source protection of both surface water and groundwater sources (available at http://www.mass.gov/dep/brp/dws/dwshome.htm). These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. MA DEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act. DWP has also initiated work on its Source Water Assessment Program (SWAP), which requires that the Commonwealth delineate protection areas for all public ground and surface water sources, inventory land uses in these areas that may present potential threats to drinking water quality, determine the susceptibility of water supplies to contamination from these sources, and publicize the results.

Public water suppliers monitor their finished water (tap water) for major categories of both naturally occurring and man-made contaminants, such as: microbiological, inorganic, organic, pesticides, herbicides and radioactive contaminants. Specific information on community drinking water sources, including SWAP activities and drinking water quality information, are updated and distributed annually by the public water system to its customers in a "Consumer Confidence Report". These reports are available from the public water system, the local boards of health, MA DPH and MA DEP.

PRIMARY AND SECONDARY CONTACT RECREATIONAL USES
The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS) for any recreational or other water related activity during which there is prolonged and intimate contact with the water and there exists a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing. The *Secondary Contact Recreational Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact related to shoreline activities. For lakes, macrophyte cover and/or transparency data (Secchi disk depth) are evaluated to assess the status of the recreational uses, as well as bacteria.

Primary and Secondary Contact Recreational Uses Summary – Rivers (Figure 3)

Four segments of the Deerfield River and six tributaries to the Deerfield, totaling 102.6 miles and representing 57% of the reviewed river miles, support the *Primary Contact Recreational Use*. These same river miles were assessed as supporting the *Secondary Contact Recreational Use*. The lower 1.7 miles of Davis Mine Brook are assessed as impaired for both *Primary and Secondary Contact Recreational uses* because of poor (impaired) aesthetic quality due to the presence of objectionable deposits on the streambed that result from acid mine drainage. The number of river miles in the Deerfield River watershed impaired for Primary Contact Recreational use is 1.7 miles, representing 1% of the total reviewed river miles. The number of river miles impaired for Secondary Contact Use is 1.7, or 1% of the total reviewed river miles. Not assessed river miles for *Primary and Secondary Contact Recreational Uses* each totaled 75.1 miles.

DEERFIELD RIVER WATERSHED:
***Primary Contact Recreational Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 102.6 miles (57%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 75.1 miles (42%)**

***Secondary Contact Recreational Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 102.6 miles (57%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 75.1 (42%)**

***Primary and Secondary Contact Recreational Use* assessments for lakes**
(Total area reviewed in report is 562 acres.)

- **Support – 48 acres (9%)**
- **Not Assessed - 514 acres (91%)**

Primary and Secondary Contact Recreational Uses Summary – Lakes (Figure 3)

Two lakes (North Pond, Florida and South Pond, Savoy) totaling 48 acres were assessed as supporting both the *Primary and Secondary Contact Recreational Uses*. Due to a lack of current bacteria data the remaining 514 acres (representing 91% of the reviewed lake acreage) were not assessed in the Deerfield River Watershed.

AESTHETICS USE

The *Aesthetics Use* is supported when surface waters are free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Aesthetics Use Summary – Rivers (Figure 4)

The majority of river segments in the Deerfield River Watershed (150.8 miles representing 84% of the reviewed river miles) support the *Aesthetics Use*. The lower 1.7 miles of Davis Mine Brook is impaired for this use due to the presence of objectionable deposits on the streambed that result from acid mine drainage. The upper portion of Davis Mine Brook and the remaining six segments (totaling 26.9 miles and representing 15% of the reviewed river miles) were not assessed.

DEERFIELD RIVER WATERSHED:
***Aesthetics Use* assessment for rivers**
(Total length reviewed in report is 179.4 miles.)

- **Support – 150.8 miles (84%)**
- **Impaired – 1.7 miles (1%)**
- **Not Assessed – 26.9 miles (15%)**

***Aesthetics Use* assessments for lakes**
(Total area reviewed in report is 562 acres.)

- **Not Assessed – 562 acres (100%)**

Aesthetics Use Summary – Lakes (Figure 4)

Due to a lack of current information none of the lake acreage was assessed in the Deerfield River Watershed for this use.

DEERFIELD RIVER WATERSHED

Aquatic Life Use Assessment Summary – Rivers and Lakes

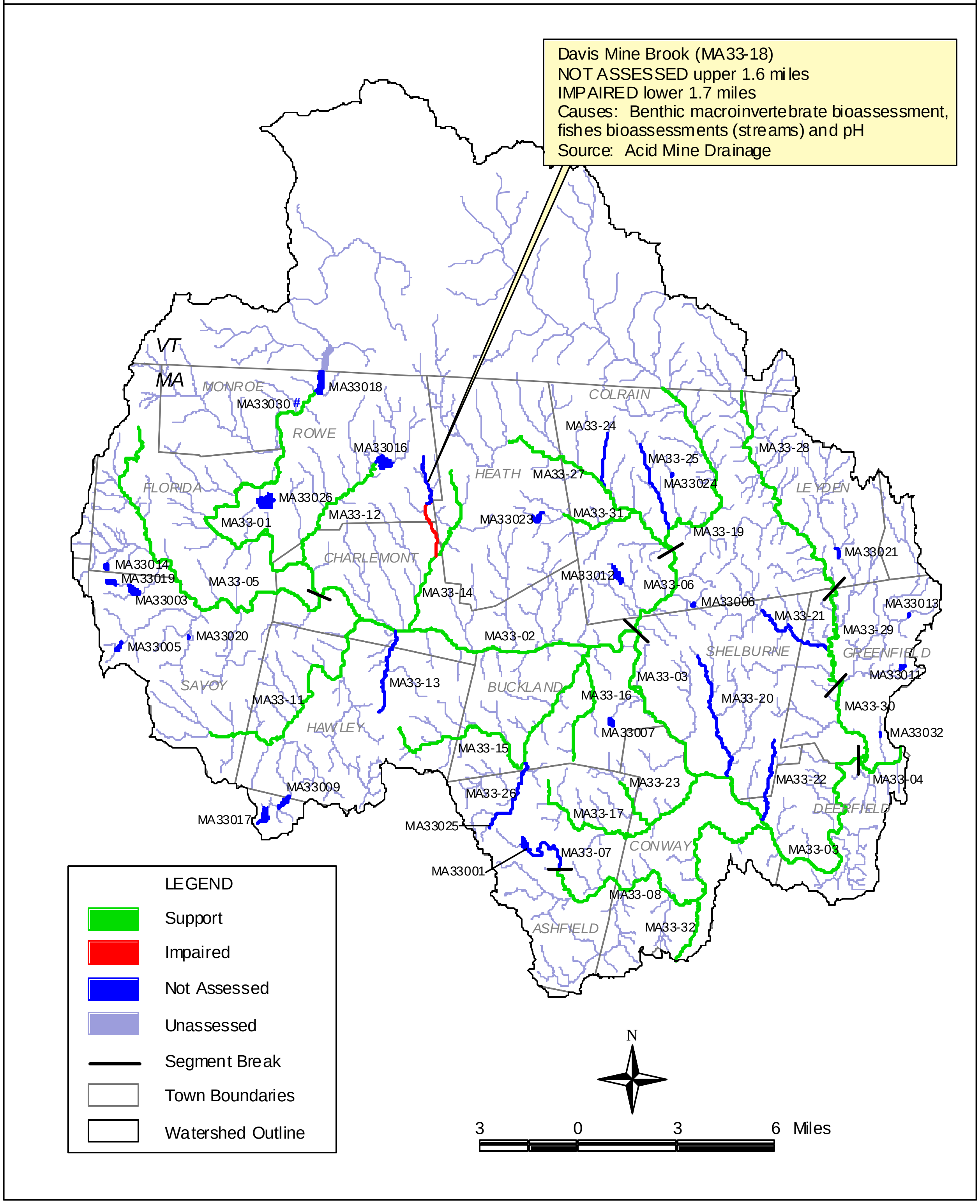

Figure 1. Deerfield River Watershed *Aquatic Life Use* Assessment Summary.

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DEERFIELD RIVER WATERSHED

Fish Consumption Use Assessment Summary – Rivers and Lakes

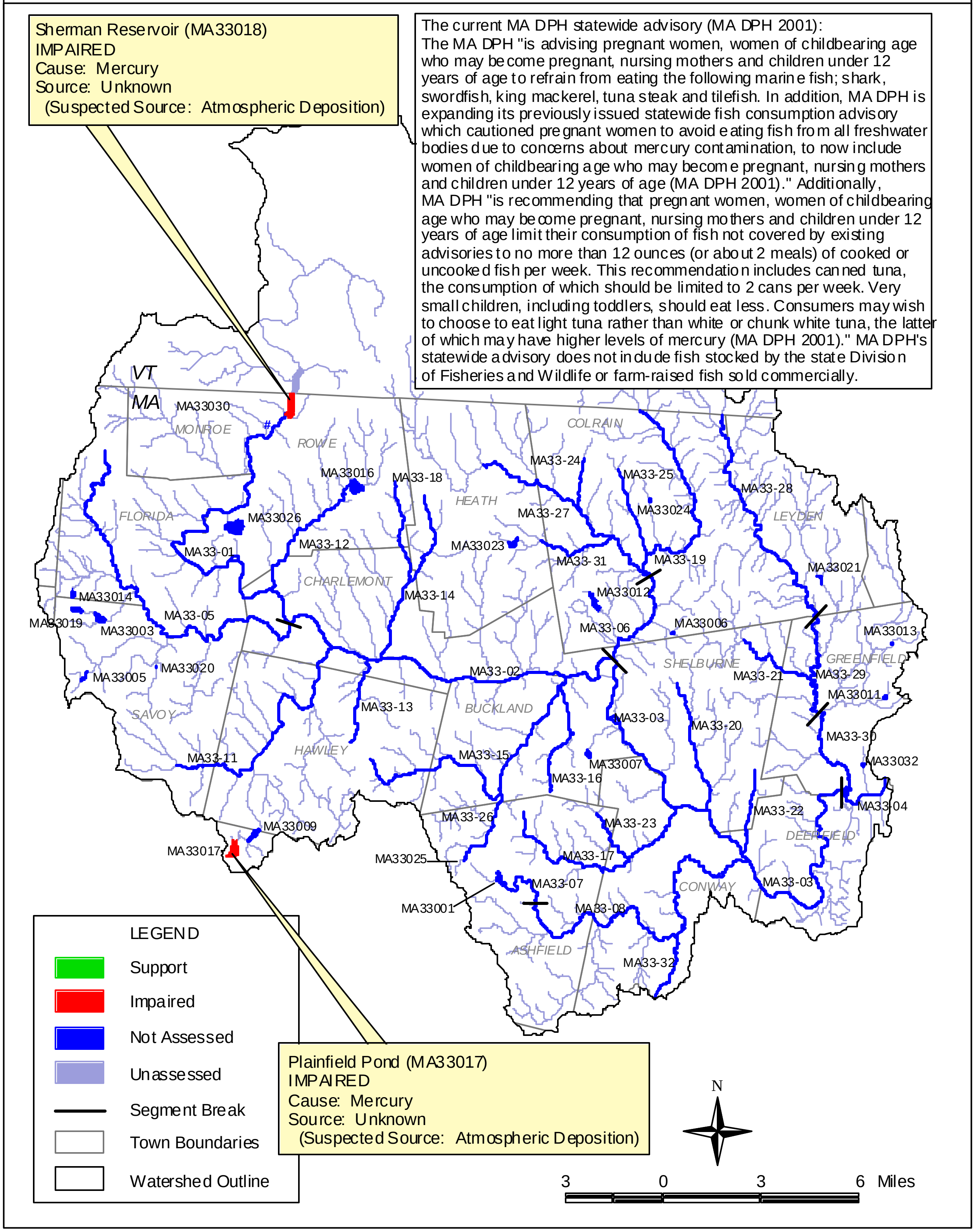

Figure 2. Deerfield River Watershed *Fish Consumption Use* Assessment Summary.

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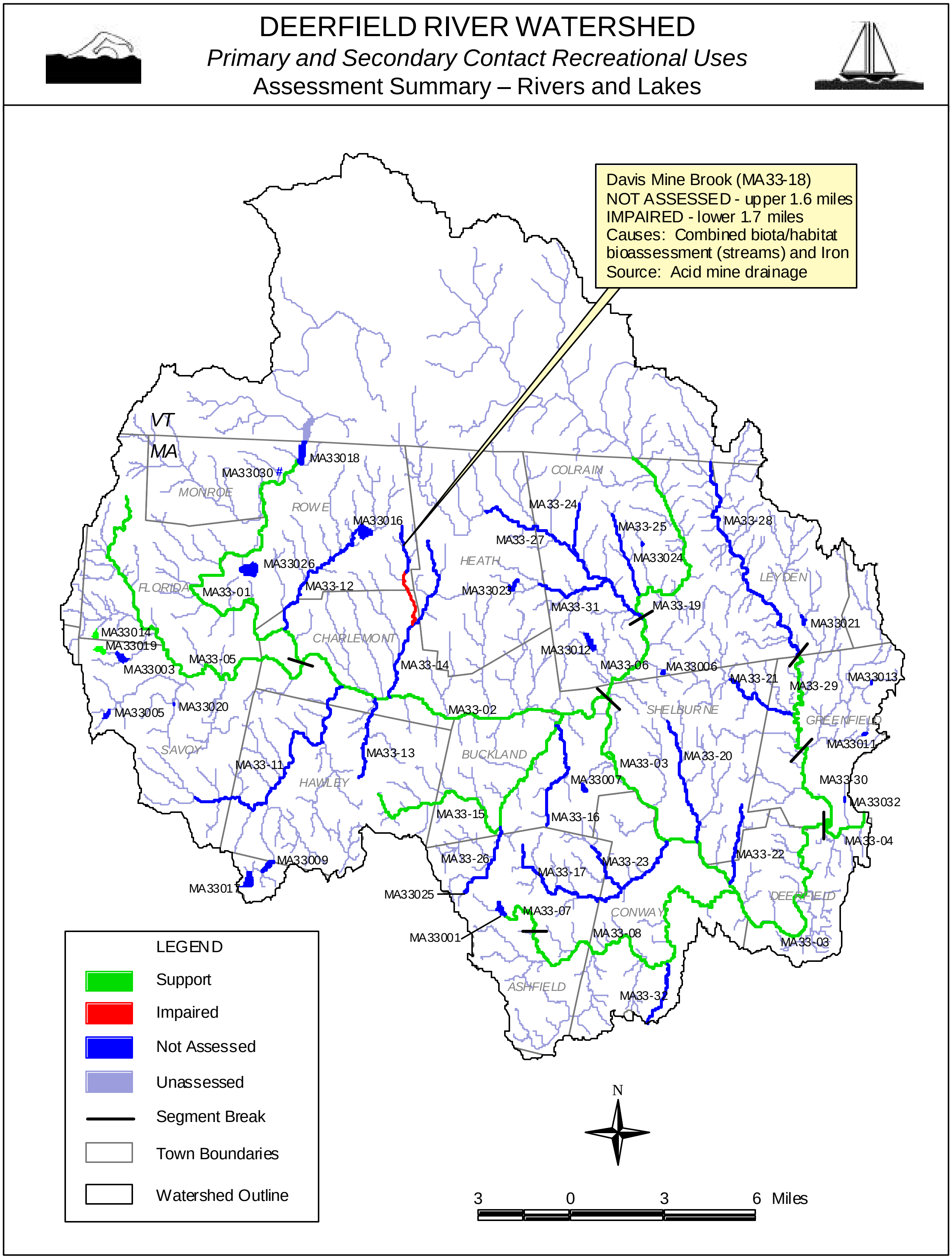

Figure 3. Deerfield River Watershed *Primary* and *Secondary Contact Recreational Uses* Assessment Summary.

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DEERFIELD RIVER WATERSHED

Aesthetics Use Assessment Summary – Rivers and Lakes

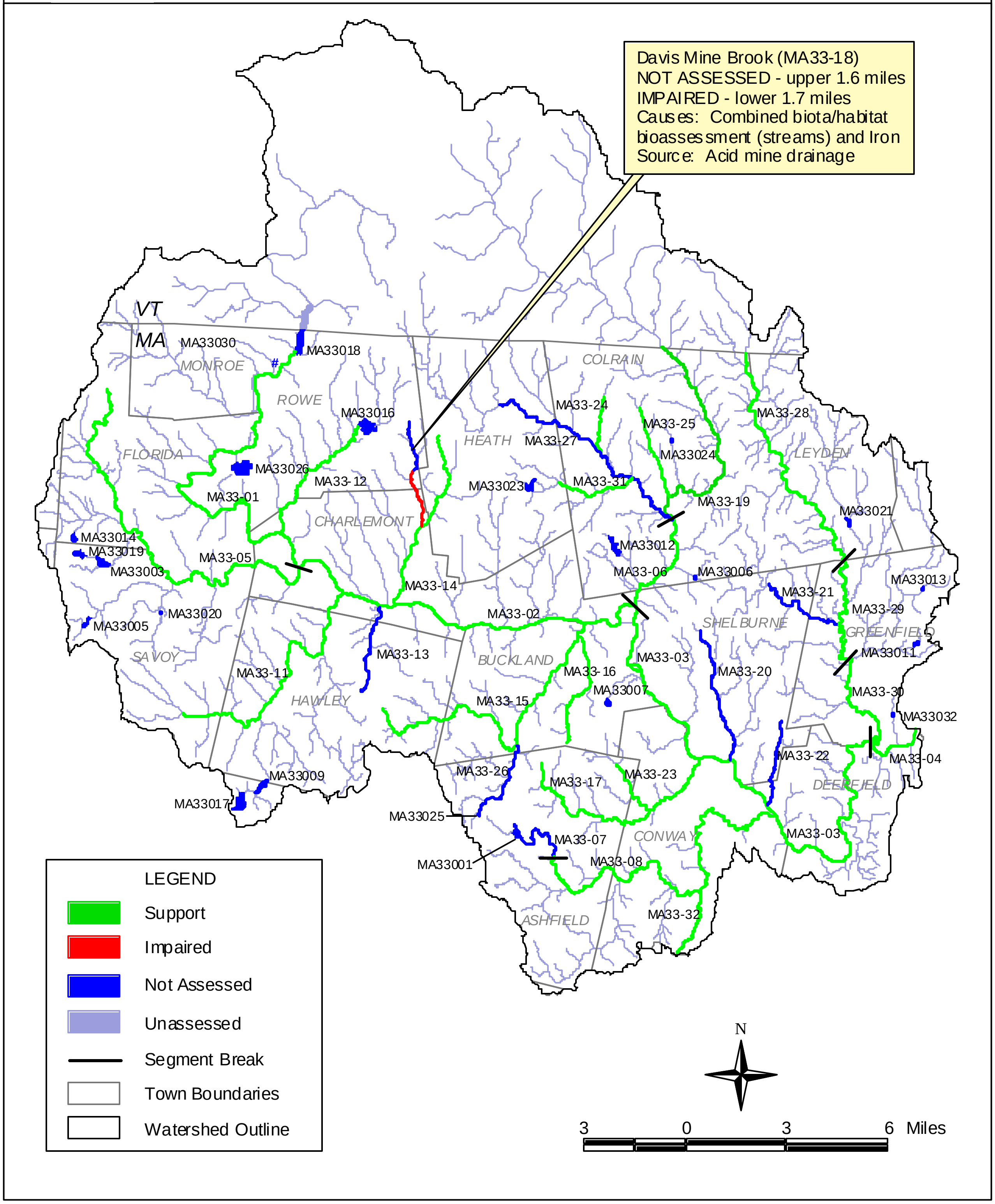

Figure 4. Deerfield River Watershed *Aesthetics Use* Assessment Summary

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RECOMMENDATIONS

In addition to specific actions identified for each individual segment, this assessment report has revealed the need for the following actions to be taken throughout the Deerfield River Watershed to protect, restore and/or improve water quality conditions.

- In view of the illegal dumping that occurs throughout the watershed, educational programs should be offered to inform residents of the negative effects of illegal solid waste dumping on the water quality and communities should be encouraged to provide incentives to residents for proper disposal of household items and building materials.
- Most communities in the watershed rely on septic systems for wastewater disposal. Efforts should be made, therefore, to ensure that on-site systems are properly sited, maintained and inspected.
- In order to prevent degradation of water quality in the watershed it is recommended that land use planning techniques be applied to direct development to desired zones, preserve sensitive areas, and maintain or reduce the impervious cover. Communities should review the information generated through the buildout analysis performed by EOEA that created a profile of how the community would look at full buildout according to its current zoning and follow the recommendations to protect priority and/or sensitive water resources described in their individual town open space plans and the watershed-wide open space plan (EOEA 2000 - 2001).
- According to the Massachusetts Natural Heritage and Endangered Species Program there are approximately 440 potential vernal pools in the Deerfield River Watershed. Currently, only 10 of these pools have been officially certified (Maher 2001). These potential vernal pools should be prioritized for protection measures and to pursue a course of certification to obtain further protection under the Wetlands Protection Act.
- Efforts should continue to document and describe the barriers to migration of fish and wildlife in tributaries of the Deerfield River similar to the road-stream crossing inventory work done by volunteers in the Bear River subwatershed. Information can be used to help determine if crossings are a barrier to fish and wildlife movement, and cause habitat fragmentation. Barriers that are identified can be prioritized for potential remediation.
- MA DFWELE has recommended that 61 streams and 164 river miles be protected as cold water fishery habitat based on surveys they have conducted in the watershed.
- Continue to conduct biological and water quality monitoring to evaluate the effect(s), if any, of National Pollutant Discharge Elimination System (NPDES) discharges, water withdrawals, power plant operations, and nonpoint sources of pollution and to document any changes in water quality conditions as a result of infrastructure improvements/pollution abatement controls.
- Encourage the use of riparian buffers on private and public lands to protect water and habitat quality.
- Monitor and control the spread and growth of exotic, invasive aquatic and wetland vegetation. Determine the effectiveness of various control options on the non-native plant growth. Prevent the spread of these plants to unaffected areas by alerting lake-users and landowners to the problem and the responsibility of spreading these exotic species.
- As part of the Water Management Act (WMA) 5-year review process MA DEP should continue to evaluate compliance with registration and/or permit limits for withdrawals in the Deerfield River Watershed. Work with water suppliers to encourage the development and implementation of local watershed and wellhead protection plans.
- Support the efforts of the Massachusetts Division of Fish and Game, Riverways Program to organize and direct stream teams in subwatersheds of the Deerfield River in order to document and address local non-point source problems affecting water quality.
- Although none of the communities in the Deerfield River Watershed are currently regulated as operators of small municipal separate storm sewer systems under the EPA Stormwater Phase II NPDES permit, it is recommended that municipalities in the watershed with urban centers proactively develop and implement appropriate stormwater management BMPs to protect water quality.
- Coordinate with the Deerfield Watershed Team and other groups to support the implementation of the Deerfield River Watershed Action Plan being developed for EOEA.
- Encourage and support efforts of citizen groups, such as the DRWA and Trout Unlimited, to build watershed awareness, foster watershed stewardship, and increase the number of volunteers active in watershed education and protection projects, such as river cleanups, volunteer water quality and wetlands monitoring, and the Atlantic Salmon Egg Rearing Project.

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INTRODUCTION

The Massachusetts Watershed Approach is a collaborative effort between state and federal environmental agencies, municipal agencies, citizens, non-profit groups, businesses and industries in the watershed. The mission is to improve water quality conditions and to provide a framework under which the restoration and/or protection of the watershed's natural resources can be achieved. Figure 5 illustrates the management structure to carry out the mission. This report presents the current assessment of water quality conditions in the Deerfield River Watershed. The assessment is based on information that has been researched and developed by the Massachusetts Department of Environmental Protection (MA DEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle in partial fulfillment of MA DEP's federal mandate to report on the status of the Commonwealth's waters under the Federal Water Pollution Control Act (commonly known as the Clean Water Act).

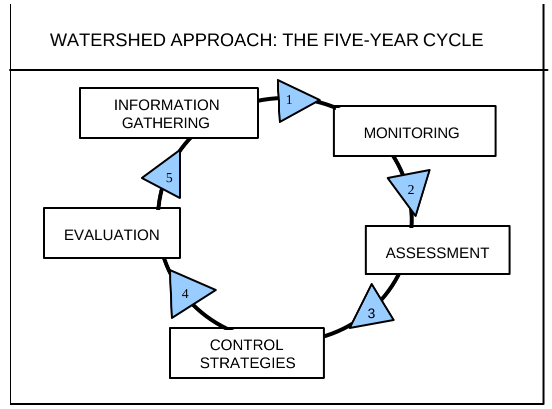


Figure 5. Five-year cycle of the Watershed Approach

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). To meet this objective the CWA requires states to develop information on the quality of the Nation's water resources and report this information to the U.S. Environmental Protection Agency (EPA), the United States Congress, and the public. Together these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal Clean Water Act MA DEP must submit a statewide report every two years to the EPA that describes the status of water quality in the Commonwealth. Up until 2002 this was accomplished as a statewide summary of water quality (the 305(b) Report). States are also required to submit, under Section 303(d) of the CWA, a list of impaired waters requiring a total maximum daily load (TMDL) calculation. In 2002, however, EPA recommended to states that they combine elements of the statewide 305(b) Report and the Section 303(d) list of impaired waters into one "Integrated List of Waters". This statewide list is based on the compilation of information for the Commonwealth's 27 watersheds. Massachusetts has opted to write individual watershed water quality assessment reports and use them as the supporting documentation for the Integrated List. The assessment reports utilize data compiled from a variety of sources and provide an evaluation of water quality, progress made towards maintaining and restoring water quality, and the extent to which problems remain at the watershed level. Instream biological, habitat, physical/chemical, toxicity data and other information are evaluated to assess the status of water quality conditions. This analysis follows a standardized process described below (Assessment Methodology). Once the use assessments have been completed the segments are categorized for the Integrated List.

ASSESSMENT METHODOLOGY

WATER QUALITY CLASSIFICATION

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected; prescribe minimum water quality criteria required to sustain the designated uses; and include provisions for the prohibition of discharges (MA DEP 1996a). These regulations should undergo public review every three years. The surface waters are segmented and each segment is assigned to one of the six classes described below. Each class is identified by the most sensitive and, therefore, governing water uses to be achieved and protected. Surface waters may be suitable for other beneficial uses, but shall be regulated by the Department of Environmental Protection to protect and enhance the designated uses.

Inland Water Classes

1. ***Class A*** *– These waters are designated as a source of public water supply. To the extent compatible with this use they shall be an excellent habitat for fish, other aquatic life* and *wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters (ORWs) under 314 Code of Massachusetts Regulations (CMR) 4.04(3).*
2. ***Class B*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.*
3. ***Class C*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife, and for secondary contact recreation. These waters shall be suitable for the irrigation of crops used for consumption after cooking and for compatible industrial cooling and process uses. These waters shall have good aesthetic value.*

Coastal and Marine Classes

4. ***Class SA*** *– These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfishing Areas). These waters shall have excellent aesthetic value.*
5. ***Class SB*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfishing Areas). These waters shall have consistently good aesthetic value.*
6. ***Class SC*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife and for secondary contact recreation. They shall also be suitable for certain industrial cooling and process uses. These waters shall have good aesthetic value.*

The CWA Section 305(b) water quality reporting process is an essential aspect of the Nation's water pollution control effort. It is the principal means by which EPA, Congress, and the public evaluate existing water quality, assess progress made in maintaining and restoring water quality, and determine the extent of remaining problems. In so doing, the States report on waterbodies within the context of meeting their designated uses (described above in each class). Each class is identified by the most sensitive and, therefore, governing water uses to be achieved and protected. These uses include: *Aquatic Life, Fish Consumption, Drinking Water, Primary Contact Recreation, Secondary Contact Recreation, Shellfish Harvesting* and *Aesthetics*. Two subclasses of Aquatic Life are also designated in the standards: Cold Water Fishery (capable of sustaining a year-round population of cold water aquatic life, such as trout) and Warm Water Fishery (waters that are not capable of sustaining a year-round population of cold water aquatic life).

The SWQS, summarized in Table 1, prescribes minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MA DEP 1996a). In rivers the lowest flow conditions at and above which aquatic life criteria must be applied are the lowest mean flow for seven consecutive days to be expected once in ten years (7Q10). In artificially regulated waters the lowest flow conditions at which aquatic life criteria must be applied are the flow equal or exceeded 99% of the time on a yearly basis or another equivalent flow that has been agreed upon. In coastal and marine waters and for lakes the most severe hydrological condition for which the aquatic life criteria must be applied shall be determined by MA DEP on a case-by-case basis.

The availability of appropriate and reliable scientific data and technical information is fundamental to the 305(b) reporting process. It is EPA policy (EPA Order 5360.1 CHG 1) that any organization performing work for or on behalf of EPA establish a quality system to support the development, review, approval, implementation, and assessment of data collection operations. To this end, MA DEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the MA DEP are of known and documented quality and are suitable for their intended use. For external sources of information MA DEP requires the following: 1. an appropriate *Quality Assurance Project Plan* including a laboratory Quality Assurance /Quality Control (QA/QC) plan, 2. use of a state certified lab (or as otherwise approved by MA DEP for a particular analysis), and 3. sample data, QA/QC and other pertinent sample handling information are documented in a citable report.

EPA provides guidelines to the States for making their use support determinations (EPA 1997 and 2002, Grubbs and Wayland III 2000 and Wayland III 2001). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered “historical” and used for descriptive purposes, they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table 1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance in the literature may be applied in lieu of actual numerical criteria (e.g., freshwater sediment data may be compared to *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* 1993 by D. Persaud, R. Jaagumagi and A. Hayton). Excursions from criteria due solely to “naturally occurring” conditions (e.g., low pH in some areas) do not constitute violations of the standards.

Each designated use within a given segment is individually assessed as ***support*** or ***impaired***. When too little current data/information exists or no reliable data are available the use is ***not assessed***. In this report, however, if there is some indication that water quality impairment may exist, which is not “naturally occurring”, the use is identified with an “Alert Status”. Detailed guidance for assessing the status of each use follows in the Designated Uses Section of this report. It is important to note that not all waters are assessed. Many small and/or unnamed ponds, rivers, and estuaries are currently ***unassessed***; the status of their designated uses has never been reported to EPA in the Commonwealth’s 305(b) Report or the Integrated List of Waters nor is information on these waters maintained in the waterbody system database (WBS) or the new assessment database (ADB).

Table 1. Summary of Massachusetts Surface Water Quality Standards (MA DEP 1996a and MA DPH 2002b).

Dissolved Oxygen	Class A, Class B Cold Water Fishery (BCWF), and Class SA: ≥6.0 mg/L and ≥75% saturation unless background conditions are lower Class B Warm Water Fishery (BWWF) and Class SB: ≥5.0 mg/L and ≥60% saturation unless background conditions are lower Class C: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤3.0 mg/L anytime unless background conditions are lower; levels cannot be lowered below 50% saturation due to a discharge Class SC: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤4.0 mg/L anytime unless background conditions are lower; and 50% saturation; levels cannot be lowered below 50% saturation due to a discharge
Temperature	Class A: ≤68°F (20°C) and ∆1.5°F (0.8°C) for Cold Water and ≤83°F (28.3°C) and ∆1.5°F (0.8°C) for Warm Water. Class BCWF: ≤68°F (20°C) and ∆3°F (1.7°C) due to a discharge Class BWWF: ≤83°F (28.3°C) and ∆3°F (1.7°C) in lakes, ∆5°F (2.8°C) in rivers Class C and Class SC: ≤85°F (29.4°C) nor ∆5°F (2.8°C) due to a discharge Class SA: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and ∆1.5°F (0.8°C) Class SB: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and ∆1.5°F (0.8°C) between July through September and ∆4.0°F (2.2°C) between October through June
pH	Class A, Class BCWF and Class BWWF: 6.5 - 8.3 SU and ∆0.5 outside the background range. Class C: 6.5 - 9.0 SU and ∆1.0 outside the naturally occurring range. Class SA and Class SB: 6.5 - 8.5 SU and ∆0.2 outside the normally occurring range. Class SC: 6.5 - 9.0SU and ∆0.5 outside the naturally occurring range.
Solids	All Classes: *These waters shall be free from floating, suspended, and settleable solids in concentrations or combinations that would impair any use assigned to each class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.*
Color and Turbidity	All Classes: *These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.*
Oil and Grease	Class A and Class SA: *Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.* Class SA: *Waters shall be free from oil and grease and petrochemicals.* Class B, Class C, Class SB and Class SC: *Waters shall be free from oil* and *grease, petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course or are deleterious or become toxic to aquatic life.*
Taste and Odor	Class A and Class SA: *None other than of natural origin.* Class B, Class C, Class SB and Class SC: *None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to each class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.*
Aesthetics	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.*
Toxic Pollutants	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife… The Division shall use the recommended limit published by EPA pursuant to 33 USC 1251, 304(a) as the allowable receiving water concentrations for the affected waters unless a site-specific limit is established*.
Nutrients	*Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.*

Note: *Italics are direct quotations.*
∆ criterion (referring to a change from natural background conditions) is applied to the effects of a permitted discharge.

Table 1. Summary of Massachusetts Surface Water Quality Standards (MA DEP 1996a and MA DPH 2002b) - *Continued*.

Bacteria (MA DEP 1996a and MA DPH 2002b) Class A criteria apply to the *Drinking Water Use*. Class B and SB criteria apply to *Primary Contact Recreation Use* while Class C and SC criteria apply to *Secondary Contact Recreation Use*.	<u>Class A</u>: • Fecal coliform bacteria: An arithmetic mean of <20 cfu/100 mL in any representative set of samples and <10% of the samples >100 cfu/100 mL. <u>Class B</u>: • At public bathing beaches, as defined by MA DPH, where *E. coli* is the chosen indicator: No single *E. coli* sample shall exceed 235 *E. coli* /100 mL and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 *E. coli* / 100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 61 *Enterococci* /100 mL and the geometric mean of the most recent five *Enterococci* samples within same bathing season shall not exceed 33 *Enterococci* /100 mL. • Current standards for other w aters (not designated as bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) <u>Class C</u>: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 cfu/100 mL, nor shall 10% of the samples exceed 2000 cfu/100 mL. <u>Class SA</u>: • Fecal coliform bacteria: Waters approved for open shellfishing shall not exceed a geometric mean (most probable number (MPN) method) of 14 MPN/100 mL, nor shall more than 10% of the samples exceed 43 MPN/100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mL and the geometric mean of the five most recent *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mL. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) <u>Class SB</u>: • Fecal coliform bacteria: In waters approved for restricted shellfish, a fecal coliform median or geometric mean (MPN method) of <88 MPN/100 mL and <10% of the samples >260 MPN/100 mL. • At public bathing beaches, as defined by MA DPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mL and the geometric mean of the most recent five *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mL. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 cfu/100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 mL. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) <u>Class SC</u>: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 cfu/100 mL, nor shall 10% of the samples exceed 2000 cfu/100 mL.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MA DEP 1996a).

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna. Two subclasses of aquatic life are also designated in the standards for freshwater bodies: *Cold Water Fishery* - capable of sustaining a year-round population of cold water aquatic life, such as trout; *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life.
- *FISH CONSUMPTION* - pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption.
- *DRINKING WATER* - used to denote those waters used as a source of public drinking water. They may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3).
- *SHELLFISH HARVESTING* (in SA and SB segments) – Class SA waters in approved areas (Open Shellfish Areas) shellfish harvested without depuration shall be suitable for consumption; Class SB waters in approved areas (Restricted Shellfish Areas) shellfish harvested with depuration shall be suitable for consumption.
- *PRIMARY CONTACT RECREATION* - suitable for any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water. These include, but are not limited to, wading, swimming, diving, surfing and water skiing.
- *SECONDARY CONTACT RECREATION* - suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities.
- *AESTHETICS* - all surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *AGRICULTURAL AND INDUSTRIAL* - suitable for irrigation or other agricultural process water and for compatible industrial cooling and process water.

The guidance used to assess the *Aquatic Life, Fish Consumption, Drinking Water, Shellfish Harvesting, Primary* and *Secondary Contact Recreation* and *Aesthetics* uses follows.

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the MA DEP's data collection techniques dictate that a weight of evidence be used to make the assessment, with biosurvey results used as the final arbiter of borderline cases. The following chart provides an overview of the guidance used to assess the status (support or impaired) of the *Aquatic Life Use*:

Variable	***Support -*** Data available clearly indicates support or minor modification of the biological community. Excursions from chemical criteria (Table 1) not frequent or prolonged and may be tolerated if the biosurvey results demonstrate support.	***Impaired*** There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY		
Rapid Bioassessment Protocol (RBP) III*	Non/Slightly impacted	Moderately or Severely Impacted
Fish Community	Best Professional Judgment (BPJ)	BPJ
Habitat and Flow	BPJ	Dewatered streambed due to artificial regulation or channel alteration, BPJ
Eelgrass Bed Habitat (Howes et al. 2002)	No/minimal loss, BPJ	Moderate/severe loss, BPJ
Macrophytes	BPJ	Exotic species present, BPJ
Plankton/Periphyton	No/infrequent algal blooms	Frequent and/or prolonged algal blooms
TOXICITY TESTS**		
Water Column/Ambient	≥75% survival either 48 hr or 7-day exposure	<75% survival either 48 hr or 7-day exposure
Sediment	≥75% survival	<75% survival
CHEMISTRY-WATER**		
Dissolved oxygen (DO)/percent saturation (MA DEP 1996a, EPA 1997)	Infrequent excursion from criteria (Table 1), BPJ (minimum of three samples representing critical period)	Frequent and/or prolonged excursion from criteria [river and shallow lakes: exceedances >10% of measurements; deep lakes (with hypolimnion): exceedances in the hypolimnetic area >10% of the surface area].
pH (MA DEP 1996a, EPA 19 November 1999)	Infrequent excursion from criteria (Table 1)	Criteria exceeded >10% of measurements.
Temperature (MA DEP 1996a,EPA 1997)	Infrequent excursion from criteria (Table 1)	Criteria exceeded >10% of measurements.
Toxic Pollutants (MA DEP 1996a, EPA 1999b) Ammonia-N (MA DEP 1996a, EPA 1999a) Chlorine (MA DEP 1996a, EPA 1999b)	Infrequent excursion from criteria (Table 1) 1.32 mg/L NH_3-N [2] 0.011 mg/L total residual chlorine (TRC)[3]	Frequent and/or prolonged excursion from criteria (exceeded >10% of measurements).
CHEMISTRY-SEDIMENT**		
Toxic Pollutants (Persaud et al. 1993)	Concentrations ≤ Low Effect Level (L-EL), BPJ	Concentrations ≥ Severe Effect Level (S-EL)[4], BPJ
CHEMISTRY-TISSUE		
PCB – whole fish (Coles 1998)	≤500 µg/kg wet weight	BPJ
DDT (Environment Canada 1999)	≤14.0 µg/kg wet weight	BPJ
PCB in aquatic tissue (Environment Canada 1999)	≤0.79 ng TEQ/kg wet weight	BPJ

*RBP II analysis may be considered for assessment decision on a case-by-case basis, **For identification of impairment, one or more of the following variables may be used to identify possible causes/sources of impairment: NPDES facility compliance with whole effluent toxicity test and other limits, turbidity and suspended solids data, nutrient (nitrogen and phosphorus) data for water column/sediments. [2] [NH_3-N] at pH = 7.7 SU and 30°C, actual "criterion" varies with pH and temperature and is evaluated case-by-case. [3] The minimum quantification level for TRC is 0.05 mg/L. [4]For the purpose of this report, the S-EL for total polychlorinated biphenyl compounds (PCB) in sediment (which varies with Total Organic Carbon (TOC) content) with 1% TOC is 5.3 ppm while a sediment sample with 10% TOC is 53 ppm.

Note: National Academy of Sciences/National Academy of Engineering (NAS/NAE) guideline for maximum organochlorine concentrations (i.e., total PCB) in fish tissue for the protection of fish-eating wildlife is 500µg/kg wet weight (ppb, not lipid-normalized). PCB data (tissue) in this report are presented in µg/kg wet weight (ppb) and are not lipid-normalized to allow for direct comparison to the NAS/NAE guideline.

FISH CONSUMPTION USE

Pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption. The assessment of this use is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2002a). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption. Hence, the *Fish Consumption Use* is assessed as non-support in these waters.

In July 2001, MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001).

1. The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)."
2. Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)."

Other statewide advisories that MA DPH has previously issued and are still in effect are as follows (MA DPH 2001):

1. "Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.
2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species."

The following is an overview of EPA's guidance used to assess the status (support or impaired) of the *Fish Consumption Use*. Because of the statewide advisory no waters can be assessed as support for the *Fish Consumption Use*. Therefore, if no site-specific advisory is in place the *Fish Consumption Use* is not assessed.

Variable	***Support*** No restrictions or bans in effect	***Impaired*** There is a "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species or there is a commercial fishing ban in effect
MA DPH Fish Consumption Advisory List (MA DPH 2001, MA DPH 2002a)	Not applicable, precluded by statewide advisory (Mercury)	Waterbody on MA DPH Fish Consumption Advisory List

Note: MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

DRINKING WATER USE

The term *Drinking Water Use* denotes those waters used as a source of public drinking water. These waters may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). They are designated for protection as Outstanding Resource Waters in 314 CMR 4.04(3). MA DEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The status of the supplies is currently reported to MA DEP and EPA by the suppliers on an annual basis in the form of a consumer confidence report (http://yosemite.epa.gov/ogwdw/ccr.nsf/Massachusetts). Below is EPA's guidance to assess the status (support or impaired) of the drinking water use.

Variable	***Support*** No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	***Impaired*** Has one or more advisories or more than conventional treatment is required or has a contamination-based closure of the water supply.
Drinking Water Program (DWP) Evaluation	See note below	See note below

Note: While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at http://www.mass.gov/dep/brp/dws/dwshome.htm and from the Deerfield River Watershed's public water suppliers.

SHELLFISH HARVESTING USE

This use is assessed using information from the Department of Fisheries, Wildlife and Environmental Law Enforcement's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (described below) with respect to shellfish harvest. Shellfish areas under management closures are *not assessed.* Not enough testing has been done in these areas to determine whether or not they are fit for shellfish harvest, therefore, they are closed for the harvest of shellfish.

Variable	***Support*** SA Waters: Approved[1] SB Waters: Approved[1], Conditionally Approved[2] or Restricted[3]	***Impaired*** SA Waters: Conditionally Approved[2], Restricted[3], Conditionally Restricted[4], or Prohibited[5] SB Waters: Conditionally Restricted[4] or Prohibited[5]
DMF Shellfish Project Classification Area Information (MA DFWELE 2000)	Reported by DMF	Reported by DMF

NOTE: Designated shellfish growing areas may be viewed using the MassGIS datalayer available from MassGIS at http://www.state.ma.us/mgis/dsga.htm. This coverage currently reflects classification areas as of July 1, 2000.

[1] **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

[2] **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

[3] **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

[4] **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

[5] **Prohibited -** Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water during the primary contact recreation season (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support or impaired) of the *Primary Contact Recreation Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use
Bacteria (105 CMR 445.000) Minimum Standards for Bathing Beaches State Sanitary Code) (MA DEP 1996a)	At "public bathing beach" areas: formal beach postings/advisories neither frequent nor prolonged during the swimming season (the number of days posted or closed cannot exceed 10% during the locally operated swimming season). Other waters: samples* collected during the primary contact season must meet criteria (Table 1). Shellfish Growing Area classified as "Approved" by DMF.	At "public bathing beach" areas: formal beach closures/postings >10% of time during swimming season (the number of days posted or closed exceeds 10% during the locally operated swimming season). Other waters: samples* collected during the primary contact season do not meet the criteria (Table 1).
Aesthetics (MA DEP 1996a) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period*).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period*).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

* Data sets to be evaluated for assessment purposes must be representative of a sampling location (minimum of five samples per station recommended) over the course of the primary contact season. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use. An impairment decision will not be based on a single sample (i.e., the geometric mean of five samples is <200 cfu/100 mL but one of the five samples exceeds 400 cfu/100 mL). The method detection limit (MDL) will be used in the calculation of the geometric mean when data are reported as less than the MDL (e.g., use 20 cfu/100 mL if the result is reported as <20 cfu/100 mL). Those data reported as too numerous to count (TNTC) will not be used in the geometric mean calculation; however, frequency of TNTC sample results should be presented.

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. The following is an overview of the guidance used to assess the status (support or impaired) of the *Secondary Contact Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use
Fecal Coliform Bacteria (MA DEP 1996a)	Other waters: samples* collected must meet the Class C or SC criteria (see Table 1).	Other waters: samples* collected do not meet the Class C or SC criteria (see Table 1).
Aesthetics (MA DEP 1996a) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged*, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged*, BPJ.
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (minimum of five samples per station recommended) over time. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use.

AESTHETICS USE

All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. The aesthetic use is closely tied to the public health aspects of the recreational uses (swimming and boating). Below is an overview of the guidance used to assess the status (support or impaired) of the *Aesthetics Use*.

Variable	***Support*** Narrative "free from" criteria met	***Impaired*** Objectionable conditions frequent and/or prolonged
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged*, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged*, BPJ.
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

DEERFIELD RIVER WATERSHED DESCRIPTION AND CLASSIFICATION

DESCRIPTION

The Deerfield River Watershed (Figures 6 and 7) occupies a total of 665 mi^2 (1738 km^2). Approximately half of the watershed is in southern Vermont (318mi^2) and half lies in the Franklin and Berkshire Counties of western Massachusetts (347mi^2). The Deerfield River is a major tributary to the Connecticut River and extends 70.2 mainstem river miles from the river's source on Stratton Mountain (VT) to its mouth in Greenfield, MA.

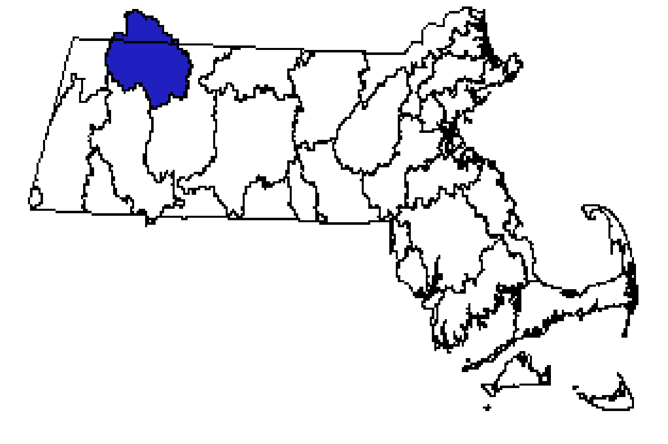


Figure 6. Location of the Deerfield River Watershed in MA showing southern portion of the watershed area in VT.

The beginning of the Deerfield River in Massachusetts is at the outlet of Sherman Reservoir dam in Monroe and Rowe, Massachusetts. Sherman Reservoir lies across the Vermont-Massachusetts border and is fed by the drainage of both the main branch of the Deerfield River and the South Branch of the Deerfield River in Vermont. From the outlet of Sherman Reservoir dam in Massachusetts the river flows generally south and then easterly 44 miles to its confluence with the Connecticut River.

In Massachusetts most of the drainage area is in the Berkshire Hills physiographic province where the topography consists of narrow river valleys bordered by steep slopes. The southeastern part of the basin is part of the Connecticut Valley Lowlands physiographic province where the topography is flatter than the Berkshire Hills. Land surface altitudes in the basin range from 120 feet above sea level in the Connecticut Valley Lowlands to 2,841 feet above sea level in the Berkshire Hills. Average annual precipitation ranges from 44 inches in the low altitudes of the southeast to 50 inches in the higher altitudes in the western part of the basin.

The Deerfield River Watershed in Massachusetts is bordered by the Hoosic River Watershed to the west, the Westfield River Watershed to the south, and the Connecticut River Watershed to the east. Major tributaries to the Deerfield River in Massachusetts, in order of decreasing drainage area are: the North River (92.9 mi^2), the Green River (89.8 mi^2), the Cold River (31.7 mi^2), the Chickley River (27.4 mi^2), the South River (26.3 mi^2), and Clesson Brook (21.2 mi^2).

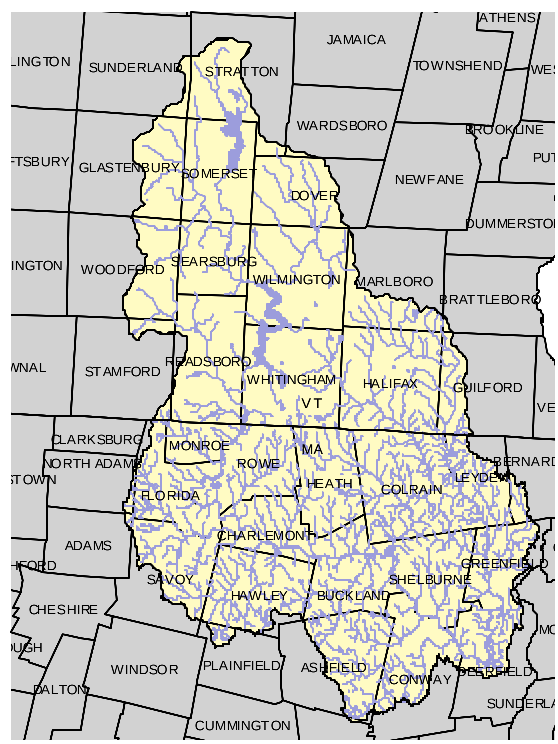


Figure 7. Deerfield River Watershed Towns in VT and MA.

Twenty communities, including Adams, Ashfield, Bernardston, Buckland, Charlemont, Colrain, Conway, Deerfield, Florida, Goshen, Greenfield, Hawley, Heath, Leyden, Monroe, North Adams, Plainfield, Rowe, Savoy, and Shelburne, lie wholly or partially within the Massachusetts area drained by the Deerfield River. The total population of all the aforementioned towns is 40,229 (US Census Bureau 2003). The Vermont portion of the watershed contributes a population of approximately 7,000 (VTDEC 1992). In Massachusetts landuse within this predominately rural watershed is classified as 81% forested, 13% agriculture/open land, 4% urban, and 2% water. The southern portion of the watershed contains most of the population, so the land use, although still heavily forested, contains more of a mix of agricultural, residential, and industrial uses. The largest, and only city in the watershed is Greenfield, MA (population 18,168) and contains almost half the population in the entire watershed (US Census Bureau 2003). It is located in the southern part of the watershed at its most downstream end near the Deerfield's confluence with the Connecticut River.

There are currently ten facilities with permitted NPDES discharges in the watershed – five municipal wastewater treatment plants (Monroe, Charlemont, Buckland/Shelburne, Old Deerfield, and Greenfield), and five industrial dischargers (Yankee Atomic Electric Company in Rowe, BBA Nonwovens in Colrain, US GenNE and Consolidated Edison hydroelectric projects, and WTE Recycling). The largest discharger is the Greenfield wastewater treatment plant, which was renovated in 1998. Its discharge was moved from the Green River to the mainstem Deerfield. The Town of Ashfield uses a modified design of a Solar Aquatics facility to treat its municipal wastewater, which discharges to groundwater in the South River subwatershed. The Yankee Nuclear Power Station in Rowe, MA is located on the southeastern shore of Sherman Reservoir. This facility has been permanently shutdown since February 1992 and has been actively decommissioning since that time. Sherman Reservoir provided a source of cooling water when the reactor was in operation.

In the northern and western areas of the watershed the topography is mountainous and the river's profile is steep, which makes it attractive for hydroelectric power generation. The river gradient averages 28.4 ft/mi from the Vermont border to the streamflow-gaging station at West Deerfield, a distance of about 33 river miles. The United States Geological Survey (USGS) maintains five flow monitoring stations in the Massachusetts portion of the watershed; two on the mainstem and one in each of the North, South and Green River subwatersheds. Along the mainstem there are 9 licensed hydroelectric stations (7 in MA, including a pumped storage facility) and 10 associated dams, which effectively control the flow of the river. Because the water released from the hydroelectric facility dams affects the entire range of stream flow and causes multiple daily stream stage fluctuations in the mainstem a detailed description of the hydroelectric system is provided here.

In Vermont drainage from the Green Mountains forms the headwaters of the Deerfield River. The water is impounded in the Somerset Reservoir (1,514 acres) and then again in the Searsburg Reservoir (30 acres). From there the river flows into Harriman Reservoir (2,039 acres), the most downstream development in Vermont. Water from Harriman Reservoir may either be released to the Deerfield River or sent through a bypass pipe to a generating station on Sherman Reservoir.

Downstream from the Harriman Dam, in the Town of Readsboro, VT, the West Branch of the Deerfield River joins the mainstem of the Deerfield River. From this confluence water is impounded to form Sherman Reservoir (218 acres), which straddles the Vermont and Massachusetts border. From the dam and hydroelectric powerhouse on Sherman Reservoir the river flows for a short distance to the Deerfield Hydroelectric Station Number Five Dam. Sherman Reservoir and Number Five Station dam are so close that no lotic habitat is present between them. The water is released from pool to pool. The Number Five Station Dam has a FERC license minimum flow requirement of 73 cfs or inflow from upstream, and inflow cannot be less than 57 cfs guaranteed from Harriman Reservoir. The license also provides for thirty-two whitewater releases (average 1,000 cfs) from April to October. For power production the station releases water to a bypass pipe leading to a generating facility downstream on the Fife Brook Reservoir. Before a new FERC license was executed in 1997 this stretch of river was known as the "Dryway" because, except in times of flood, the entire flow of the river was piped to the generating facility on Fife Brook Reservoir.

Once the water reaches the Fife Brook Impoundment it may be used to fill the Bear Swamp Pumped Storage Facility on Negus Mountain. Water is pumped up to this pond and released down through the mountain via vertical pipes to generate electricity during periods of peak demand. All Deerfield River water returns to the Fife Brook Impoundment. Under the FERC license the year-round minimum flow requirement from the Fife Brook Dam is 125 cfs. FERC mandated whitewater releases (minimum flow of 700 cfs) occur 102 times between April and October.

Below Fife Brook Dam the unimpounded Cold River merges with the Deerfield River. From this confluence the river enters the Town of Charlemont, MA (population ~1,300) (US Census Bureau 2003). In addition, several smaller rivers and streams, such as Pelham Brook, the Chickley River, Bozrah Brook, and Clesson Brook, enter the mainstem before encountering Deerfield Hydroelectric Station Number Four dam. The FERC license minimum flow requirement for this dam is 100 cfs or inflow from upstream from October 1 – May 31 and 125 cfs from June 1 to September 30.

The North River joins the mainstem just below this dam. The Deerfield then flows approximately 2 miles and is again impounded by Deerfield Hydroelectric Station Number Three Dam. Minimum flow requirements at Number Three are 100 cfs or inflow. Just below this dam are the historic "Glacial Potholes". Again, after just 0.4 miles the river is impounded by the Gardner Falls Hydroelectric Facility Dam. The year round FERC minimum flow requirement from this dam is 150 cfs or inflow. Deerfield Hydroelectric Station Number Two is the last generating facility and dam on the mainstem. Minimum flow requirements from this dam are 200 cfs guaranteed flow. Below this final impoundment the river flows for 9 miles to its confluence with the Connecticut River. The South River and then the Green River join the Deerfield River in this stretch.

Besides the mainstem dams, there are at least 45 additional dams located in the tributary subwatersheds of Massachusetts (MA DCR 2003). The majority of these structures are no longer maintained or in use. Several function to impound local water supply reservoirs or to form a number of lakes and ponds in the watershed.

There are relatively few (24) named lakes and ponds in the Massachusetts portion of the Deerfield watershed. About half (10) are located within MA DCR State Forest lands and the other half are privately owned, town owned, or are town-owned water supply reservoirs. The total surface acreage of all of the Deerfield Watershed lakes in Massachusetts is approximately 563 acres.

CLASSIFICATION

Consistent with the National Goal Uses of “fishable and swimmable waters”, the classification of waters in the Deerfield River Basin according to the Massachusetts Surface Water Quality Standards (SWQS) include the following (MA DEP 1996a).

Class A Waters

These waters are designated as a source of public water supply. To the extent compatible with their use they shall be an excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. All Class A waters are designated for protection as ORWs under 314 CMR 4.04(3).

In the Deerfield River Watershed, the following waterbodies are classified as A.

- Upper Reservoir and Lower Reservoir (Highland Springs), source to outlet in Ashfield and those tributaries thereto (Note: Lower Reservoir no longer exists and will be removed from the list of Class A waterbodies in the next revision of the SWQS.)
- Unnamed Reservoir (Mt. Spring Reservoir, Mountain Brook Reservoir), source to outlet in Colrain and those tributaries thereto
- Greenfield Reservoir (Glen Brook Upper Reservoir), source to outlet in Leyden and those tributaries thereto
- Unnamed Reservoir (Fox Brook Upper Reservoir), source to outlet in Colrain and those tributaries thereto
- Unnamed Reservoir (Phelps Brook Reservoir), reservoir outlet in Monroe and those tributaries thereto
- The MA DEP/Division of Water Supply has recommended that the Green River and its tributaries from the VT border to the Greenfield pumping station dam near the Greenfield/Colrain town line be reclassified from Class B to a Class A public water supply waterbody in the next revision of the SWQS.

The designation of ORW is applied to those waters with exceptional socio-economic, recreational, ecological and/or aesthetic values. ORWs have more stringent requirements than other waters because the existing use is so exceptional or the perceived risk of harm is such that no lowering of water quality is permissible. ORWs include certified vernal pools (CVPs), all designated Class A Public Water Supplies, and may include surface waters found in National Parks, State Forests and Parks, Areas of Critical Environmental Concern (ACEC) and those protected by special legislation (MA DEM 1993). Wetlands that border ORWs are designated as ORWs to the boundary of the defined area.

Vernal pools are small, shallow ponds characterized by lack of fish and by periods of dryness. Vernal pool habitat is extremely important to a variety of wildlife species including some amphibians that breed exclusively in vernal pools, and other organisms such as fairy shrimp, which spend their entire life cycles confined to vernal pool habitat. Many additional wildlife species utilize vernal pools for breeding, feeding and other important functions. Certified vernal pools are protected if they fall under the jurisdiction of the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00). Certified vernal pools are also afforded protection under the state Surface Water Quality Standards, the state Water Quality Certification regulations (401 Program), the state Title 5 regulations, and the Forest Cutting Practices Act regulations. However, the certification of a pool only establishes that it functions biologically as a vernal pool. Certification does not determine that the pool is within a resource area protected by the Wetlands Protection Act.

Within the Deerfield Watershed there are currently ten Certified Vernal Pools (CVPs) (Maher 2001). These are located in the Towns of Hawley, Conway, and Buckland. Species of special concern observed in these pools include the spotted turtle (*Clemmys guttata*). Other obligate vernal pool species observed include the spotted salamander (*Ambystoma maculatum*), the wood frog (*Rana sylvatica*), and the Jefferson Salamander (*Ambystoma jeffersonianum*).

Class B Waters

These waters are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.

In the Deerfield River Watershed the following waterbodies are classified as B Cold Water Fisheries.

- Deerfield River, Vermont-Massachusetts State Line to confluence with North River
- North River, East and West Branches from the Vermont-Massachusetts State Line to confluence with the Deerfield River
- Green River, Vermont-Massachusetts State Line to confluence with the Deerfield River.

In the Deerfield River Watershed the following waterbody is classified as B Warm Water Fishery.

- Deerfield River, North River confluence to confluence with the Connecticut River.

Unlisted waters in the Deerfield River Watershed not otherwise designated in the SWQS are designated *Class B, High Quality Waters* for inland waters. According to the SWQS where fisheries designations are necessary they shall be made on a case-by-case basis.

SUMMARY OF EXISTING CONDITIONS AND PERCEIVED PROBLEMS

The general perception of most people who live in or visit the area is that the environmental quality of the Deerfield Watershed is excellent. The rural character of the watershed has helped to protect the environment from the impacts of point and non-point sources of pollution common to more urbanized areas. Throughout the watershed there are, however, localized water quality problems that arise from a variety of land use activities that cause non-point source pollution. The EOEA, Massachusetts Watershed Initiative, Deerfield Watershed Team's annual workplans from 1999 to 2004 have identified a number of issues of concern related to environmental degradation of the watershed including: stormwater runoff impacts to the Green River in Greenfield, sedimentation of streams from rural road runoff, invasive plants, localized failing septic systems, localized wetland fillings, localized agricultural impacts, old municipal landfills, acid mine drainage into Davis Mine Brook in Rowe, sewage contamination into Maple Brook in Greenfield, flow alterations from hydropower generation in the mainstem, illegal ORV use in state forests, need for emergency planning for potential hazardous materials spills into the river from nearby major rail and truck transportation routes, and impeded fish passage and instream habitat degradation from dams (EOEA 1999, 2000, 2001, 2002, 2003 and 2004).

There are over 50 dams in the Massachusetts portion of the Deerfield watershed (MA DCR 2003). Many of these dams no longer fulfill the role for which they were built or any subsequent purpose. However, their presence alters flow patterns, reduces riverine habitat, impedes fish movement, may change water temperature, and potentially changes other water physicochemical parameters. Since many of these relict dams are no longer maintained they may pose a threat to human lives, ecosystems, and downstream properties. Sediments deposited behind dams also often contain contaminants from upstream industrial, agricultural, and other sources. In 2000 the US Army Corps of Engineers began a Feasibility Study of four dams on the Green River in Greenfield, funded by the Executive Office of Environmental Affairs, Deerfield River Watershed Team. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or fish passage structures on these dams as well as other potential stream ecosystem restoration activities. The project is expected to be completed in late 2004. Recommendations may include dam removal and/or fish passage structures at Wiley Russell Dam and Mill Street Dam and fish passage structures for the still functioning Swimming Pool Dam and the Water Supply Dam. Implementation of the recommendations is optional, however funding may be available from ACOE for up to 65% of the cost if Greenfield decides to follow them.

Although there are large blocks of protected open space in some watershed communities, there are also many towns that have very little permanently protected open space. The need for ongoing open space planning and protection to address habitat loss and fragmentation and non-point source pollution from increasing development is a key concern in the watershed. The Franklin Regional Council of Governments recently completed a Deerfield Watershed Regional Open Space and Recreation Plan as well as several individual watershed town Open Space and Recreation Plans with funds from the Executive Office of Environmental Affairs, Deerfield Watershed Team. A municipal and regional Open Space Plan was also developed for several watershed communities by Dodsen Associates with EOEA, Deerfield Watershed Team funding. Buildout analysis and maps were also prepared for all of the watershed towns by the Massachusetts Community Preservation Initiative in EOEA.

The Deerfield Watershed is used heavily for recreation. MA DCR (formerly MA DEM) owns state forest lands covering over 15% of the watershed (Franklin County Planning Department, 1990) and these provide many camping, hiking, swimming, birding, fishing, cross-county skiing, snowmobiling, hunting, and sightseeing opportunities. Access to the Deerfield River for boating, fishing, and picnicking is provided at numerous sites by the hydropower companies as required by their FERC license. Both commercial whitewater boating companies and private citizens heavily use the upper Deerfield River for rafting, kayaking, canoeing and inner tubing. In recent years concerns about river safety have increased, particularly because of the increasing number of private boaters that may be unfamiliar with safe whitewater boating practices. In addition, safety risks to other river users such as fishermen are an ongoing concern because of the rapid changes in flow caused by the releases of water from the dams for hydropower generation. The hydropower companies have implemented a number measures to warn river users of the danger of rapidly rising water from releases from the dams and continue to work with user groups to enhance these measures.

The Clean Water Act Section 303(d) requires states to identify those waterbodies that are not meeting standards and prioritize the development of TMDLs for these waterbodies. Table 2 identifies the waterbodies in the Deerfield River Watershed on the most recent, EPA approved, 1998 Massachusetts Section 303(d) List of Waters (MA DEP 1999a).

Table 2. 1998 303(d) List of Waters in the Deerfield River Watershed.

Name, Town	Waterbody Identification Code (WBID)	Cause of Impairment
Bog Pond, Savoy	MA33003	Noxious Aquatic Plants
Burnett Pond, Savoy	MA33005	Noxious Aquatic Plants
Goodnow Road Pond, Buckland	MA33007	Noxious Aquatic Plants
Hallockville Pond, Hawley/Plainfield	MA33009	Noxious Aquatic Plants
Little Mohawk Road Pond, Shelburne[1]	MA33027	Noxious Aquatic Plants
McLeod Pond, Colrain	MA33012	Noxious Aquatic Plants
Pelham Lake, Rowe	MA33016	Noxious Aquatic Plants
Plainfield Pond, Plainfield	MA33017	Noxious Aquatic Plants

Table 2 continued. 1998 303(d) List of Waters in the Deerfield River Watershed.

Name, Town	Waterbody Identification Code (WBID)	Cause of Impairment
Schneck Brook Pond, Conway[1]	MA33029	Noxious Aquatic Plants
Deerfield River[2], Charlemont/ Shelburne	MA33-02	Unknown Toxicity, Metals, and Chlorine
Chickley River[2], Savoy/Hawley	MA33-11	Pathogens
Davis Mine Brook[2], Rowe/Charlemont	MA33-18	pH, Other Habitat Alterations
North River, Colrain/Shelburne	MA33-06	Pathogens, Taste, Odor and Color
South River, Ashfield/Conway	MA33-08	Pathogens, Other Habitat Alterations (Cause Unknown)
Green River, Colrain/Greenfield	MA33-09[3]	Pathogens, Metals (Cause Unknown)

[1] These ponds have been removed from the PALIS database for this assessment report because it has been determined that they no longer exist as lakes due to dam failure and/or they have filled in with aquatic vegetation.
[2] Needing confirmation
[3] Now WBID MA33-30

The northeastern United States has been identified as receiving elevated rates of mercury deposition from the atmosphere and having high levels of mercury contamination in freshwater fishes (Tatsutani 1998). All forms of mercury are toxic to humans and have no known function in any normal biological process. Mercury can be transformed into methylmercury. The ability of methylmercury to bind to proteins (e.g., muscle tissues) contributes to its ability to biologically concentrate into aquatic organisms by factors ranging from 10,000 to 1,000,000 its concentration in water (Stein, et. al., 1996). Aside from point discharges, most of the mercury contamination in the northeastern United States has been linked to air emissions (incineration, fossil fuel combustion, and sewage treatment plant operation) and agricultural practices (herbicides, fungicides) from both local and distant up-wind sources. The primary vector of mercury exposure in people is through the consumption of contaminated foodstuffs. As a result of this risk, the MA DPH, like the other New England States, has issued a statewide fish consumption advisory. MA DPH is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. MA DPH has also expanded its previously issued statewide fish consumption advisory, which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001).

In addition, MA DPH has issued the following site-specific fish consumption advisory due to elevated levels of mercury for Sherman Reservoir in Rowe/Monroe: children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body; the general public should not consume any yellow perch from this water body; and the general public should limit consumption of non-affected fish from this water body to two meals per month (MA DPH, 2002a). The Vermont Department of Environmental Conservation has also identified Sherman Reservoir as having elevated fish tissue mercury concentrations and has only partially supported the *Fish Consumption Use* for this waterbody (VT DEC 2003).

SOURCES OF INFORMATION

Multiple local, private, state and federal agencies provided information used in the water quality assessment of the Deerfield River Watershed. Within MA DEP information was obtained from three programmatic bureaus: Bureau of Resource Protection (BRP, see below), Bureau of Waste Prevention (industrial wastewater discharge information) and the Bureau of Waste Site Cleanup (hazardous waste site cleanup information). Specifically, water quality, habitat assessment, biological and lake data were provided by MA DEP, Division of Watershed Management (DWM), Watershed Planning Program. Water withdrawal and wastewater discharge permit information were provided by members of the Deerfield River Watershed Team in the MA DEP, Western Regional Office, as well as the DWM, Watershed Permitting Program.

The Deerfield River and some of its tributaries receive discharges of treated municipal and industrial wastewater, contact and non-contact cooling water, etc. (Appendix H, Tables H1 and H2). The following types of National Pollutant Discharge Elimination System (NPDES) discharges occur in the Deerfield River Watershed (Hogan 2003).

- *Municipal wastewater treatment plants (WWTPs).* These facilities treat wastewater from domestic and industrial sources within the WWTP service area. Five WWTPs discharge to the Deerfield River or its tributaries. They are: Old Deerfield Municipal Treatment Facility (MA0101940), Monroe Wastewater Treatment facility (MA0100188), Town of Charlemont Wastewater Treatment Facility (MA0103101), Shelburne Falls Waste Water Treatment Facility (MA0101044), and Greenfield Wastewater Treatment Facility (MA0101214). All of the municipal wastewater treatment facilities discharge to the mainstem of the Deerfield River. These discharges range in size from the Monroe WWTP that is authorized to discharge an average monthly flow of 0.015 MGD to the Greenfield WWTP, which is currently authorized to discharge an average monthly flow of 3.2 MGD.
- *Industrial WWTPs.* BBA Nonwovens (Colrain, MA) (MA0003697) is authorized to discharge 1.35 MGD of treated wastewater to the North River.
- *Non-process discharges*. Yankee Atomic Electric Company (MA0004367) and eight hydroelectric projects (listed below) in the Massachusetts portion of the Deerfield River have NPDES permits for the discharge of cooling water and internal facility drainage (floor drains).

  Deerfield #2 Station (MA0034843)
  Deerfield #3 Station (MA0034851)
  Deerfield #4 Station (MA0034860)
  Fife Brook Station (MA0034878)
  Deerfield #5 Station (MA0034894)
  Sherman Station (MA0034908)
  Bear Swamp Station (MA0034886)
  Gardners Falls Station (MA0035670)

<u>NPDES Toxicity Testing Discharge Monitoring Reports (DMRs)</u>
All of the municipal wastewater treatment plants in the Deerfield River Watershed, and BBA Nonwovens submit toxicity testing reports to EPA and MA DEP as required by their NPDES permits. Data from these toxicity reports are maintained by DWM in a database entitled "TOXTD". Information from the reports includes: survival of test organisms exposed to ambient river water (used as dilution water), physicochemical analysis (e.g., hardness, alkalinity, pH, total suspended solids) of the dilution water, and the whole effluent toxicity test results. Data from these reports for the time period noted in parentheses were reviewed and summarized (ranges) for use in the assessment of current water quality conditions in the Deerfield River Watershed. These include:

- Old Deerfield Municipal Treatment Facility (MA0101940) (October 1996 to October 2002)
- Town of Charlemont WWTP (MA0103101) (January 1996 to August 2002)
- Shelburne Falls WWTF (MA0101044) (April 1998 to April 2003)
- Greenfield WWTP (MA0101214) (November 1999 to December 2002)
- BBA Nonwovens (MA0003697) (February 1997 to September 2002)
- Monroe Wastewater Treatment Facility (MA0100188) (April 1999 to April 2001)

There are no "Phase II" stormwater communities in the Deerfield River Watershed.

There are eight Federal Energy Regulatory Commission (FERC) licensed hydroelectric power plants in the Deerfield River Watershed in Massachusetts. A table that describes these hydroelectric facilities can be found in Appendix H, Table H3.

A list of registered and permitted Water Management Act (WMA) withdrawals (both public water suppliers and other industrial users) is provided in Appendix H, Table H4 (LeVangie 2002).

Projects funded through various state and federal grant and loan programs also provide valuable information that may be used in the water quality assessment report. A summary of these projects for the Deerfield River Watershed is provided in Appendix I.

Other state agencies contributing information to this report include: the MA DPH, the Department of Fish and Game (formerly Department of Fish and Wildlife, and Environmental Law Enforcement (MA DFWELE)), Division of Fisheries and Wildlife and Riverways programs, and the Department of Resource Conservation (DCR) (formerly Department of Environmental Management (MA DEM)). Contributing federal agencies include: EPA, United States Geological Survey (USGS), Federal Energy Regulatory Commission (FERC), and the United States Army Corps of Engineers (ACOE).

The US Army Corps of Engineers (ACOE), New England District ongoing ecosystem restoration study on the Green River in Greenfield is an outgrowth of a study originally intended to evaluate the Searsburg and Somerset dams in Vermont. ACOE will consider alternatives for fish passage at four dams on the Green River, a Deerfield River tributary, as well as other habitat enhancement opportunities (ACOE 2001).

The USGS currently maintains and operates the following five stream gaging stations within the Massachusetts portion of the Deerfield Watershed.

01170000	Deerfield River near West Deerfield	Segment MA33-03
01169900	South River near Conway	Segment MA33-08
01170100	Green River near Colrain	Segment MA33-09
01169000	North River at Shattuckville	Segment MA33-06
01168500	Deerfield River at Charlemont	Segment MA33-02

The USGS, as part of their National Water-Quality Assessment (NAWQA) Program in the Connecticut, Housatonic, and Thames River Basins Study Unit, conducted water quality sampling in the Deerfield River Basin between 1992 and 1995. A summary of their data collection by study component is provided in Table 3. Results of the USGS investigations are published in Breault and Harris (1997), Coles (1998), Garabedian *et al.* (1998), Harris (1997), and Zimmerman (1999). Under the NAWQA Program, more than 50 of the largest river basins and aquifers in the U.S. (representing 50 percent of the land area of the nation) were assessed.

Table 3. Summary of Data Collection by USGS NAWQA Program in the Deerfield River Watershed (Garabedian *et al*. 1998).

Study Component	Study Objective	Brief Description Of Sampling Effort	Frequency Of Sample Collection And Location
Contaminants in fish tissue	Determine the presence of organochlorine compounds and trace elements that can accumulate in fish tissues.	Collect white suckers and submit composite of whole fishes for inorganic compound analysis	Once per site (August 1994)
Bottom-sediment survey	Determine presence of potentially toxic compounds within the streambed sediments and evaluate their potential for adverse biological effects on aquatic organisms.	Sample depositional zones of streams for trace elements and hydrophobic organic compounds.	Once per site (August 1994)
Water chemistry – synoptic studies	Describe the short-term presence and distribution of contamination over broad areas, and determine how well the water chemistry stations represent the watershed's surface water.	Sample streams during high flow and low flow conditions for pesticides and/or nutrients, suspended sediment, organic carbon and streamflow	Once per site (August 1994)

In August 2001 the Massachusetts "Beach Bill" was enacted by the legislature and signed by the Governor (MGL. C111. S5S). This act created minimum standards for public bathing waters adjacent to any public or semi-public bathing beach in the Commonwealth. A "public bathing beach" is defined as a beach open to the general public whether or not any entry fee is charged that permits access to bathing waters. A "semi-public bathing beach" is defined as a bathing beach used in connection with a hotel, motel, trailer park, campground, apartment house, condominium, country club, youth club, school, camp, or similar establishment where the primary purpose of the establishment is not the operation of the bathing beach, and where admission to the use of the bathing beach is included in the fee paid for use of the premises. A semi-public bathing beach shall also include a bathing beach operated and maintained solely for the use of members and guests of an organization that maintains such bathing beach. Under the Beach Bill, the MA DPH was directed to establish minimum uniform water quality standards for coastal and inland beach waters as well as determining the frequency and location of testing, reporting requirements, and requirements for notifying the public of threats to human health or safety. *105 CMR 445.000: Minimum Standards for Bathing Beaches, State Sanitary Code, Chapter VII* outlines MA DPH's guidelines for the Beach Bill and is available online at http://www.state.ma.us/dph/dcs/bb4_01.pdf (MA DPH 2002b). Additionally, under the Beach Bill and MA DPH guidelines, local boards of health and state agencies are responsible for collecting samples from public beaches using testing procedures consistent with the American Public Health Association's *Standard Methods for Examination of Water and Waste Water* or methods approved by EPA. Operators of semi-public beaches are responsible for the costs of testing their beaches. Results of testing, monitoring, and analysis of public and semi-public beaches must be submitted in an annual report to MA DPH by 31 October of each year (MA DPH 2002b).

The Deerfield River Watershed Association (DRWA) is a volunteer non-profit organization that conducts volunteer monitoring in the watershed. Its mission is to preserve, protect, and enhance the natural resources of the Deerfield River watershed in southeastern Vermont and northwestern Massachusetts. DRWA began its volunteer water quality monitoring program in 1990. Currently DRWA monitors at 12 sites throughout the watershed in the spring for pH, alkalinity, temperature and dissolved oxygen. During the recreational season volunteers collect samples at 11 sites in the watershed that people use informally as "swimming holes" and test for fecal coliform bacteria to assess the safety of recreational waters. As part of a two year "Marsh Monitoring Project", DRWA volunteers surveyed more than 20 marshes in the watershed for frogs and toads and waterbirds to document the diversity of little known wildlife communities. DRWA volunteers have also recently surveyed several Deerfield subwatersheds to locate and map infestations of the invasive non-native plant – Japanese knotweed. Quality Assurance Project Plans (QAPPs) were prepared for all of these volunteer monitoring efforts. An MA DEP approved QAPP exists for the volunteer water quality monitoring program. DRWA also conducts annual river clean-ups with other organizations such as FLOW, Trout Unlimited, Zoar Outdoor, Crabapple, and the Connecticut River Source to Sea Consortium. Additional information about the DRWA can be found on their website at www.deerfieldriver.org.

ESS conducted a water and sediment quality assessment of selected sites in the Deerfield Watershed from July through November of 2000. The study was funded through DEP under a grant from the Massachusetts Watershed Initiative as part of the Deerfield River Watershed Team's annual workplan for 2000. ESS measured fecal coliform bacteria, turbidity, pH, conductivity, temperature, dissolved oxygen and flow rate at 21 sites on 3 dry and 3 wet weather sampling dates. ESS also collected sediment samples from behind 6 impoundments and tested for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, polychlorinated biphenyls (PCB), polynuclear aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), total organic carbons (TOC), percent volatile solids, and percent water. The QAPP for this study was approved by MA DEP before sampling commenced.

Between 1983 and 1985 the University of Massachusetts Water Resources Research Center Acid Rain Monitoring Project used as many as 1,000 citizen volunteers to collect and help analyze more than 40,000 samples from 2,444 lakes and 1,670 streams, respectively 87% and 69% of the named lakes and streams in the state. They also monitored a representative 453 randomly selected and 119 special interest lakes and streams for eight successive years (1985-1993) with approximately 300 volunteers. . (Godfrey, *et al.* 1996). In 2001 and 2002 the Acid Rain Monitoring Project resumed and collected samples three times per year (April, July, and October) from approximately 150 lakes and ponds. Samples were analyzed for pH, alkalinity, total phosphorus and ions. In the Deerfield River Watershed three sites were sampled in 2001 and 2002: Ashfield Lake, Ashfield; Bog Pond, Savoy; and Newell Pond, Greenfield.

TOTAL MAXIMUM DAILY LOADS (TMDLs)

As part of the Federal Clean Water Act states are required to develop TMDLs for lakes, rivers and coastal waters that do not meet SWQS as indicated by the states' 303(d) List of Impaired Waters (see Tables 1 and 2). A TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards. Further information on the 303(d) List and the TMDL Program are available on the MA DEP website at: http://www.mass.gov/dep/brp/wm/wmpubs.htm.

There are nine lakes in the Deerfield River Watershed on the 303 (d) List for which the most common cause of impairment is noxious aquatic plants (Table 2). TMDLs are expected to be developed for these lakes within five to 10 years (Mattson 2003b).

OBJECTIVES

This report summarizes information generated in the Deerfield River Watershed through *Year 1* (information gathering in 1999) and *Year 2* (environmental monitoring in 2000) activities established in the "Five-Year Cycle" of the Watershed Approach. Data collected by DWM in 2000 are provided in Appendices A, B, D, E and F of this report. Together with other sources of information (identified in each segment assessment) these data were used to assess the status of water quality conditions of lakes and rivers in the Deerfield River Watershed in accordance with EPA's and MA DEP's use assessment methods. Not all waters in the Deerfield River Watershed are included in the waterbody system database (WBS), the new assessment database (ADB), or this report.

The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Deerfield River Watershed, defined as segments in the WBS/ADB databases, currently support their designated uses (i.e., meet SWQS),
2. identify water withdrawals (habitat quality/water quantity) and/or major point (wastewater discharges) and nonpoint (land-use practices, stormwater discharges, etc.) sources of pollution that may impair water quality conditions,
3. identify the presence or absence of any non-native macrophytes in lakes,
4. identify waters (or segments) of concern that require additional data to fully assess water quality conditions,
5. recommend additional monitoring needs and/or remediation actions in order to better determine the level of impairment or to improve/restore water quality, and
6. provide information for the development of a Deerfield River Watershed action plan.

REPORT FORMAT

RIVERS

The order of river segments follows the Massachusetts Stream Classification Program (Halliwell *et al*. 1982) hierarchy. River segments are organized hydrologically (from most upstream to downstream) and tributary segments follow after the river segment into which they discharge. Each river segment assessment is formatted as follows.

SEGMENT IDENTIFICATION

Name, water body identification number (WBID), location, length, classification.

Sources of information: coding system (waterbody identification number e.g., MA33-01) used by MA DEP to reference the stream segment in databases such as 305(b) and 303(d), the Massachusetts SWQS (MA DEP 1996a), and other descriptive information.

SEGMENT DESCRIPTION

Major land-use estimates (the top three uses for the subwatershed, excluding "open water", and other descriptive information.

Sources of information: descriptive information from USGS topographical maps, base geographic data from MassGIS, land use statistics from a GIS analysis using the MassGIS land use coverage developed at a scale of 1:25,000 and based on aerial photographs taken in 1999 (UMass Amherst 1999).

SEGMENT LOCATOR MAP

Subbasin map, major river location, segment origin and termination points, and segment drainage area (gray shaded).

Sources of information: MassGIS data layers (stream segments and quadrangle maps from MassGIS 2001).

WATER WITHDRAWALS AND WASTEWATER DISCHARGE PERMIT INFORMATION

Water withdrawal, NPDES wastewater discharge

Sources of information: WMA Database Printout (LeVangie 2002); open permit files located in the Springfield Regional MA DEP Office (MA DEP 2001b).

USE ASSESSMENT

Aquatic Life, Fish Consumption, Drinking Water (where applicable – see note below), Primary Contact, Secondary Contact, and Aesthetics.

Sources of information include: MA DEP DWM 2000 Survey data (Appendix A, B, D, E and F); MA DEP DWM Toxicity Testing Database "TOXTD"; DRWA Volunteer Monitoring Data for 2001 and 2002; MA DPH Swimming Beach Water Quality Data (MA DPH 2001b and MA DPH 2002c); MA DEM beach bacteria data (MA DEM 2002); Environmental Science Services, Inc. (2002) Water and Sediment Quality Assessment of the Deerfield River Watershed. The MA DPH Freshwater Fish Consumption Advisory Lists (MA DPH 2002a and MA DPH 2001) were used to assess the *Fish Consumption Use*.

Where other sources of information were used to assess designated uses, citations were included.

[Note: Although the *Drinking Water Use* itself was not assessed in this water quality assessment report, the Class A waters were identified.]

SUMMARY

Use summary table (uses, status, causes and sources of impairment).

RECOMMENDATIONS

Additional monitoring and implementation needs.

LAKES

The assessed lakes, identified with their WBID code numbers, are listed alphabetically in the Lake Assessment Section of this report (Table 4). The status of the individual uses is summarized for these lakes. The location, acreage, trophic status, use assessments, and causes of impairment are then summarized for each individual lake (listed alphabetically).

DEERFIELD RIVER WATERSHED RIVER SEGMENTS

There are 24 named rivers/brooks, including 30 segments, assessed in this report (Figure 8). They are as follows:

MA33-01	Deerfield River	MA33-13	Bozrah Brook	MA33-23	Drakes Brook
MA33-02	Deerfield River	MA33-14	Mill Brook	MA33-24	Tissdale Brook
MA33-03	Deerfield River	MA33-15	Clesson Brook	MA33-25	Foundry Brook
MA33-04	Deerfield River	MA33-16	Clark Brook	MA33-26	Smith Brook
MA33-05	Cold River	MA33-17	Bear River	MA33-27	West Branch North River
MA33-06	North River	MA33-18	Davis Mine Brook	MA33-28	Green River
MA33-07	South River	MA33-19	East Branch North River	MA33-29	Green River
MA33-08	South River	MA33-20	Dragon Brook	MA33-30	Green River
MA33-11	Chickley River	MA33-21	Hinsdale Brook	MA33-31	Taylor Brook
MA33-12	Pelham Brook	MA33-22	Shingle Brook	MA33-32	Pumpkin Hollow Brook

The remaining rivers/brooks are currently unassessed.

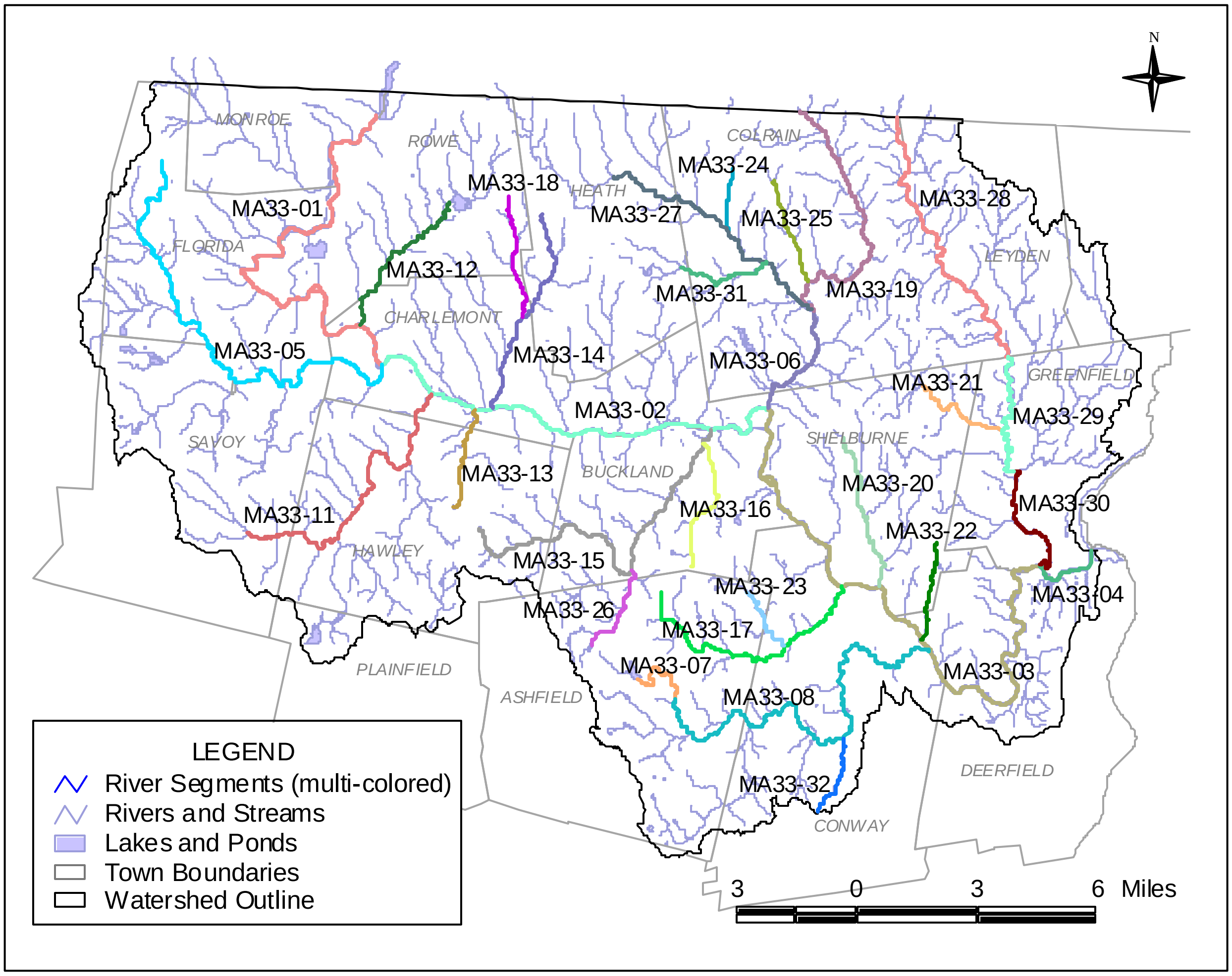
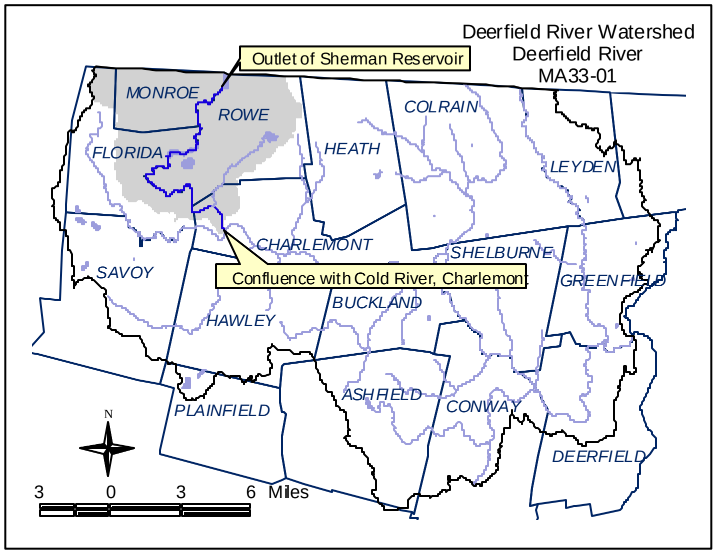


Figure 8. Deerfield River Watershed (Massachusetts Portion) – River Segment Locations identified by WBID

DEERFIELD RIVER (SEGMENT MA33-01)
Location: Outlet of Sherman Reservoir in Monroe/Rowe (formerly this segment began at the VT/MA line and included Sherman Reservoir), to confluence with Cold River, Charlemont.
Segment Length: 13.4 miles
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 43.63 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	89.8%
Open Land	2.9%
Agriculture	2.3%

The Massachusetts portion of the Deerfield River begins at the outflow from the Sherman Dam at USGenNE's Sherman Reservoir in Monroe/Rowe. From here the Deerfield River flows through Deerfield No. 5 Dam at Monroe Bridge and then twists south and west through the narrow valley forming the border first between Monroe and Rowe and then Rowe and Florida. About five miles further downstream from the Deerfield No. 5 dam the Fife Brook hydroelectric power station dam impounds the river and releases water from the hypolimnion. The Bear Swamp pumped storage facility withdraws the water from the reservoir pool behind Fife Brook Dam and pumps it to Bear Swamp Reservoir at the top of the mountain where it is used to produce power in a generating station located within the mountain. After Fife Brook Dam the river flows past the eastern portal of the Hoosic Tunnel and turns south and east entering Charlemont where the gradient lessens. This segment ends at the confluence with the Cold River along Route 2 in the Mohawk Trail State Forest, Charlemont.

MA DFWELE surveyed tributaries to this segment of the Deerfield River and has recommended that seven brooks (Dunbar, Fife, Cascade, Whitcomb, Reed, Todd, and Smith brooks) be protected as cold water fishery habitat (MassWildlife 2001).

The VT DEC assessed the Aquatic Life Use for the mainstem Deerfield River from the Harriman Reservoir outfall to the VT/MA border (Sherman Reservoir) (19.2 miles). Aquatic Life Use was supported for 13.1 miles and 6.1 miles were threatened. In the spring of 1998 Harriman Dam provided a continual minimum instream release of 70 cfs from 1 October to 30 June and 57cfs from 1 July to 30 September. This deep-water release provides a consistently cold discharge, creating an opportunity to establish a wild brook trout population. The 2003 Vermont assessment report found that wild brook trout populations in a two mile study area below Harriman Dam have been successfully restored and continue to increase in numbers, yet fish growth (mass) was depressed due to the very cold water discharged from the Harriman Dam and the naturally low fish productivity within the Deerfield watershed (VT DEC 2003).

WMA WATER WITHDRAWAL SUMMARY
Based on available information there are no WMA regulated water withdrawals in this segment of the Deerfield River.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H1 AND H2)

USGenNE is authorized to discharge via two outfalls to the Deerfield River near Monroe Bridge in Monroe (NPDES permit MA0034908 issued in September 1997). The discharges are as follows.

- Outfall 001A: 0.05 MGD maximum discharge of station sump water with oil separation
- Outfall 001B: 0.02 MGD average discharge of station sump water with oil separation

USGenNE is authorized to discharge at the Deerfield No. 5 Station via four outfalls to the Fife Brook Dam Impoundment of the Deerfield River in Florida (NPDES permit MA0034894 issued in September 1997). The discharges are as follows.

- Outfall 001A: 0.072 MGD of station sump water with oil flotation
- Outfall 001B2: 0.252 MGD bearing cooling water
- Outfall 003: 0.0126 MGD strainer backwash
- Outfall 004: <10 GPD sump water with oil flotation at the N0. 5 Dam

USGenNE is authorized to discharge at the Bear Swamp Station via two outfalls to the Fife Brook Dam Impoundment of the Deerfield River in Rowe (NPDES permit MA0034886 issued in September 1997). The discharges are as follows.

- Outfall 001: 6.58 MGD of equipment cooling water, floor and associated drain water
- Outfall 002: 0.22 MGD of strainer backwash

USGenNE is authorized to discharge at the Fife Brook Station via three outfalls to the Deerfield River in Rowe/Florida (NPDES permit MA0034878 issued in September 1997). The discharges are as follows.

- Outfall 001: 0.07 MGD of station sump water with oil flotation
- Outfall 002: 0.34 MGD of bearing cooling water
- Outfall 003: 0.009 MGD of bearing cooling water strainer backwash

The Town of Monroe is authorized to discharge from the Monroe Wastewater Treatment Facility (WTF) to the Deerfield River near the Mill Street/Monroe Bridge in Monroe (NPDES permit MA0100188 issued in September 1997). The permittee is authorized to discharge 0.015 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes ultraviolet light for disinfection.

OTHER

Hydropower (Federal Energy Regulatory Commission- FERC)

The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of two FERC licensed projects. The Deerfield River Project (L.P. No. 2323 is owned by and licensed to USGen New England, Inc. (USGenNE), formerly owned by and licensed to New England Power). FERC L.P. No. 2669, the Bear Swamp Pumped Storage Project, is owned by Bear Swamp Generating Trusts 1 and 2 and USGenNE currently operates the project and is a co-licensee. FERC L.P. No. 2323 consists of three developments in Vermont and five developments in MA; two of which are located in this segment of the Deerfield River. The FERC license for 2323 was reissued in April 1997. There are two developments on this segment of the Deerfield River authorized by FERC L.P. No. 2669. This license was issued in 1970 and amended in 1997 (FERC 1997).

- The most upstream hydropower development in MA is located at the Sherman Reservoir Dam on the Deerfield River in Rowe/Monroe authorized by FERC L.P. No. 2323. This development has one powerhouse equipped with a vertical Francis turbine unit that can generate 7,200 Kilowatts. This project includes: (1) a 100-foot-high 810-foot-long earthfill dam, (2) a 204-foot-long concrete gravity spillway, topped with four-foot-high flashboards that operate year round, (3) a concrete and brick intake structure and penstock that conveys water to the powerhouse via a concrete conduit 98 feet in length and a steel penstock 13 feet in diameter and 227 feet long, (4) an impoundment (Sherman Reservoir – Lakes Segment MA 33018), about two miles long, with a surface area of about 218 acres (72.6 acres is the MA portion only). There are currently no minimum streamflow or fish passage requirements at this development.
- The second development in MA is located at the Deerfield No. 5 Reservoir Dam in Rowe/Monroe located approximately 0.7 miles downstream from the Sherman Reservoir Dam. This development, also authorized by FERC L.P. No. 2323, includes a concrete dam 90 feet long, 35 feet high with 8 feet high hydraulic steel flap gates that can impound a surface area of about 38 acres (FERC 1997). This development has a 14,941-foot long (2.8 mile) power canal located to the west of the Deerfield River. Water from the Deerfield No. 5 Dam is diverted into this power canal and is conveyed to the powerhouse that holds one vertical Francis turbine generating unit, which can generate 17,550 Kilowatts. The hydraulic capacity of this unit is 1,250 cfs. Water then flows into the Fife Brook Reservoir. It should also be noted that flow from one tributary (Dunbar Brook) is also diverted into the power canal. The power canal bypasses approximately 3.1 miles

of the Deerfield River. A minimum flow of 73 cfs or inflow, whichever is less, is required at this development, although at no time shall the inflow be less than the 57 cfs minimum flow released from the upstream Harriman dam (VT) as specified in Article 405 of the FERC license agreement (FERC 1997). The FERC license also requires 32 whitewater releases (average 1000 cfs) between 1 April and 31 October annually from Deerfield No. 5. There are currently no fish passage requirements at this development.

- The third development in MA is the Bear Swamp Pumped Storage Project, which is located on the Deerfield River in Rowe/Florida. Although this facility operates under a different FERC license (FERC L.P. No. 2669) it is owned by Bear Swamp Generating Trusts 1 and 2 and currently leased to and operated by USGenNE, which is a co-licensee. The two generating stations at this development, the Bear Swamp Pumped Storage Facility and the Fife Brook Dam Station, were completed in 1974. The Bear Swamp pumped storage facility consists of two underground, reversible pump turbines that raise water from Fife Brook Reservoir on the Deerfield River to the Bear Swamp Upper Reservoir during hours of low power demand. The Upper Reservoir has a surface area of about 110 acres. During times of peak demand water is released back down to Fife Brook Reservoir. The capacity of the turbines at this peaking facility totals 610 megawatts. Each turbine capacity is 4,430 cfs for a total hydraulic capacity of 8,860 cfs. The Fife Brook Station (also part of FERC L.P. No. 2669) consists of a dam that is 50 feet high and 160 feet long that impounds about 2 miles of river with a surface area of approximately 75 acres. There is one powerhouse that contains one vertical Francis turbine unit with a generating capacity of 11,250 Kilowatts. A minimum flow of 125 cfs or inflow, whichever is less, is required at this development year-round. The FERC license also requires a total of 106 whitewater releases (average 1000 cfs) between 1 April and 31 October annually from Fife Brook Dam. There are currently no fish passage requirements at this development.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill, 2003), performed for the Deerfield Watershed Team and funded by the Massachusetts Watershed Initiative, identified three historic landfills in this segment, the Florida Landfill, the Monroe Bridge/Deerfield Specialty Paper landfill and the Yankee Nuclear Power Station – Southeast Construction Fill Area. The Florida Landfill is well over 25 years old and was capped in 1999 but is not lined. The site contains wood and municipal solid waste, construction/demolition debris, tires and asbestos and is upgradient of the Deerfield River (0.8 miles) and Whitcomb Brook (0.3 miles). An Initial Site Investigation conducted by MA DEP in 1998 did not recommend a Comprehensive Site Investigation. Because more extensive sampling has occurred at this site, screening level sampling was not recommended here as part of this study. The Monroe Bridge/Deerfield Specialty Paper landfill is well over 25 years old and was capped in 1996 but is not lined. The site contains municipal solid waste and paper sludge and is within one-half mile of public and private water supplies and within 200 feet of the Deerfield River. Environmental monitoring has been conducted at this site since 1995 as required by MA DEP so, consequently, screening level sampling was not recommended here as part of this study. The Yankee Nuclear Power Station landfill is over 25 years old and received construction and demolition waste. The landfill, within 500 feet of the Deerfield River, Sherman Reservoir and Wheeler Brook, has been inactive since the mid 1980's and is now capped and is currently undergoing final closure. Because extensive environmental monitoring has been conducted at this landfill since 1997 screening level sampling was not recommended here as part of this study.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The FERC license for the Deerfield Project Number 2323 at the Sherman Development currently has no minimum streamflow or fish passage requirements. The turbine capacity at this development is variable up to 1,150 cfs.

The 1997 FERC license for the Deerfield Project Number 2323 at the Deerfield No. 5 Dam currently requires a minimum flow of 73 cfs or inflow, whichever is less, to the mainstem Deerfield River and at no time shall the inflow be less than the 57 cfs minimum flow released from the upstream Harriman

Dam (VT), as specified in Article 405 of the license agreement (FERC 1997). The FERC license also requires 32 whitewater releases (average 1000 cfs) to occur between April 1 and October 31 annually from Deerfield No. 5 Dam. Historically, the entire flow of the river was diverted through the bypass pipe and canal, so the river section between Deerfield No. 5 Dam and Fife Brook impoundment was known as "the dryway" because it contained no water. The turbine capacity at the Deerfield No. 5 Station development is variable up to 1,250 cfs. As part of the requirements of the 1997 FERC license the power company has improved river access and protected the river banks by installing boat slides and stairs, as well as conducted erosion control and bank stabilization practices at the "dryway" boater access put-in downstream from the Deerfield No. 5 Dam. There are currently no fish passage requirements at this development.

The Bear Swamp pumped storage facility (1997 FERC license amendment for Project No. 2669) consists of two underground, reversible pump turbines that raise water from Fife Brook Reservoir on the Deerfield River to the Bear Swamp Upper Reservoir during hours of low power demand. During times of peak demand water is released back down to Fife Brook Reservoir. Each turbine capacity is 4,430 cfs for a total hydraulic capacity of 8,860 cfs.

According to the 1997 FERC license amendment for Project No. 2669, a minimum flow in the Deerfield River of 125 cfs must be maintained year-round downstream from the Fife Brook Dam development. The FERC license also requires 106 whitewater releases (average 1000 cfs) to occur between April 1 and October 31 annually from the Fife Brook Dam. As part of the requirements of the FERC license the power company has improved river access and protected the river banks by installing boat slides and stairs, as well as conducted erosion control and bank stabilization practices at the "Zoar Gap" boater access put-in downstream from the Fife Brook Dam. There are currently no fish passage requirements at this development.

The EOEA, Massachusetts Watershed Initiative, Deerfield Watershed Team's annual workplans from fiscal years 2001, 2002, 2003 and 2004 have reported concerns from river users about impacts from flow regulation on the mainstem (EOEA 2001, 2002, 2003 and 2004). A project to measure streamflow below Fife Brook Dam to independently monitor minimum flow releases from the dam was funded by the EOEA Deerfield Watershed Team in 2003 and was completed in January, 2004 (Gomez and Sullivan 2004). Development of a stage-discharge rating curve, installation of a series of manual water level staff gages and installation of data logging equipment in a discontinued USGS gage house to collect continuous data from a previously installed water level sensor was performed in 2003. Volunteers were trained to accurately read the manual gages and download gage height and streamflow information from the data logger. An access database was developed to store the volunteer data. Flow data from this gage is periodically transferred to the Department of Fish and Game's Riverways Program.

<u>Biology</u>
Macroinvertebrate biomonitoring was conducted in the Deerfield River upstream of Zoar Gap in the Town of Florida (Station UDR01) in 1988 and 1995 by DWM (Appendix C). No more recent data, however, were collected.

<u>Toxicity</u>
Ambient
Water from this segment of the Deerfield River was collected approximately 1000 feet upstream from the Monroe WWTF discharge for use in their whole effluent toxicity tests. Between April 1999 and April 2001 survival of *Ceriodaphnia dubia* and *Pimephales promelas* exposed (48-hour) to the river water was good ($\geq$95 and 98%, respectively).

Effluent
Five definitive acute whole effluent toxicity tests were conducted on the Monroe WWTF effluent using *C. dubia* and *P. promelas* between April 1999 and 2001. The effluent was not acutely toxic (LC_{50} >100% effluent) to either test organism during these test events ($LC_{50} \geq$ 100% effluent).

Chemistry – water

Deerfield River water was collected approximately 1000 feet upstream from the Monroe WWTF discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on five occasions between April 1999 to April 2001. Data from these reports, which are maintained in the TOXTD database by DWM, were summarized for the period between April 1999 and April 2001. Water quality sampling was also conducted by DWM in the Deerfield River approximately 800 feet downstream from Fife Brook Dam in Florida (Station UD01, see Appendix A, Figure A1 for location) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This location was also sampled by DWM between June 1995 and June 1996 (n = 9 sampling events) as was a second location on the Deerfield River approximately 0.25 miles upstream from the Florida Bridge (Station UD02) (Appendix G, tables G3 and G4). The Deerfield River Watershed Association performs volunteer water quality monitoring in this segment at a site just below Zoar Gap in Charlemont (DER-025). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not included in this assessment.

DO

DO in the Deerfield River at Station UD01 ranged from 8.5 to 9.8 mg/L and saturation was not less than 86% on the three sampling events conducted in the summer of 2000. It should be noted that these data represent the worst-case (pre-dawn conditions).

Temperature

The maximum temperature measured by DWM in the Deerfield River at Station UD01 was 17.0 $^{\circ}$C recorded during a pre-dawn survey in August 2000.

pH and Alkalinity

The pH of the Deerfield River (recorded in the TOXTD database between April 1999 and April 2001) ranged between 6.3 and 6.8 SU and 2 of the 5 measurements (40%) reported were less than 6.5 SU. Alkalinity recorded in the TOXTD database ranged from 10 to 20 mg/L. The instream pH and alkalinity of the Deerfield River (Station UD01) reported by DWM was low ranging from 5.8 to 6.5 SU and 4 to 5 mg/L, respectively (Appendix A, Tables A8 and A9, qualified data excluded).

Specific Conductance

Conductivity measurements in the Deerfield River (recorded in the TOXTD database between April 1999 and April 2001) ranged between 42 and 90 µS/cm. Measurements in the river downstream from Fife Brook Dam (Station UD01) ranged from 33.7 to 36.6 µS/cm (Appendix A, Table A8).

Suspended Solids

Suspended solids measurements in the Deerfield River (Station UD01) were very low ranging between <1.0 to 2.3 mg/L (Appendix A, Table A9).

Turbidity

Measurements for turbidity in the Deerfield River (Station UD01) were very low ranging between 1.3 to 2.4 mg/L NTU (Appendix A, Table A9, qualified data excluded).

Ammonia-Nitrogen

No detectable concentrations of ammonia-nitrogen were documented in the Deerfield River (Station UD01; Appendix A, Table A9).

Nitrate-Nitrogen

Measurements for nitrate-nitrogen in the Deerfield River (Station UD01) ranged from 0.09 to 0.12 mg/L (Appendix A, Table A9).

Phosphorus

Total phosphorus measured by DWM in the Deerfield River (Station UD01) ranged from 0.012 to 0.013 mg/L (Appendix A, Table A9).

Total Residual Chlorine
The maximum reported TRC measurement for this segment of the Deerfield River (recorded in the TOXTD database upstream of the Monroe WWTF between April 1999 and 2001) was 0.04mg/L. All five measurements were below the minimum quantification level of 0.05 mg/L.

Hardness
Hardness reported for this segment of the Deerfield River (recorded in the TOXTD database upstream of the Monroe WWTF between April 1999 and 2001) ranged between 8 and 18 mg/L. Hardness measured by DWM in the Deerfield River (Station UD01) ranged from 7.6 to 8.3 mg/L (Appendix A, Table A9, qualified data excluded).

The *Aquatic Life Use* is assessed as support based on the good survival of test organisms exposed to the Deerfield River and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users' observations regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2002, EOEA 2003 and EOEA 2004). It is USGen New England, Inc.'s first priority to continue to operate hydropower facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria sampling was conducted by the DRWA in the Deerfield River downstream from Zoar Gap in Charlemont (Station DER-025) between June and August 2001 and 2002 (n = 8 sampling events). Fecal coliform counts at this station ranged from 0 to 12 colonies/100 mL even during five wet weather sampling events (DRWA 2001 and DRWA 2002).

Fecal coliform bacteria sampling was conducted by DWM in the Deerfield River approximately 800 feet downstream from Fife Brook Dam in Florida (Station UD01) between June 1995 and June 1996 (n = 9 sampling events) as was a second location on the Deerfield River approximately 0.25 miles upstream from the Florida Bridge (Station UD02; Appendix G, Table G4).

With the exception of the FERC hydropower projects, much of this segment of the Deerfield River is undeveloped and the mainstem flows through steep, rugged valleys, providing some of the most beautiful scenery in Massachusetts. It attracts a large number of visitors (for boating, fishing, hiking, picnicking, swimming, sightseeing) mainly during the spring, summer, and fall. Litter is sometimes found at many of the public access points along the mainstem. However, the whitewater boating company, Zoar Outdoor, coordinates an annual river cleanup on the upper Deerfield River and litter and trash are removed from instream by rafters and along the roadsides and river banks by volunteers from Trout Unlimited and the Deerfield River Watershed Association and other local groups. In addition, the hydropower company, USGenNE provides funding for trash dumpsters and disposal annually for this project.

Based on the low fecal coliform bacteria data and the generally excellent aesthetic conditions along this segment the *Recreational* and *Aesthetics Uses* are assessed as support.

Deerfield River (MA33-01) Use Summary Table

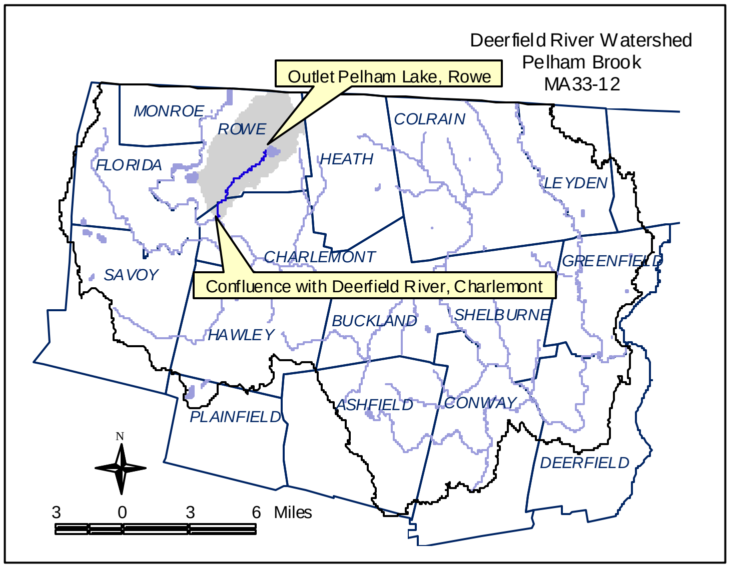
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT*	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

* "Alert Status" issues identified, see details in the use assessment section

RECOMMENDATIONS DEERFIELD RIVER (MA33-01)

- Continue to perform DWM water quality and biological monitoring of this segment during the next monitoring year cycle (2005). Refer to recommendations in Appendix C, 1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring. Because of the fish consumption advisory in place for Sherman Reservoir immediately upstream of this segment, fish tissue sampling should be conducted in this segment to assess the *Fish Consumption* use.
- Biological surveys designed to assess impacts of hydroregulation on aquatic biota would be useful to investigate concerns voiced by members of the Deerfield Watershed Team that habitat and benthic macroinvertebrates downstream from Fife Brook Dam may be affected by frequent water level changes and rapid ramping rates that result from hydropower production.
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Support the recommendations of the Massachusetts Watershed Initiative/Deerfield River Watershed Team's Deerfield River Flow Monitoring Project that enabled volunteers to monitor stream flow below Fife Brook Dam (Gomez and Sullivan 2004). Volunteer monitoring of this gage should continue to assure all river users, the project owners, and regulatory agencies that prescribed minimum flows are being met. Flow data from the gage should continue to be made available through the Massachusetts Department of Fish and Game, Riverways Program website (www.mass.gov/dfwele/river/rifls/sites/deerfield/fifebrook119/rifls_site_page.html).
- The Towns of Monroe, Rowe and Florida should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Rowe and Florida should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- Dunbar, Fife, Cascade, Whitcomb, Reed, Todd, and Smith brooks should be protected as cold water fishery habitat, as recommended by MA DFWELE.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.

PELHAM BROOK (SEGMENT MA33-12)
Location: Outlet Pelham Lake, Rowe to confluence with Deerfield River, Charlemont.
Segment Length: 4.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 13.69 square miles
Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	87.1%
Agriculture	4.0%
Residential	3.9%

Pelham Brook, from the outlet of Pelham Lake, flows southwest through a narrow and steep valley. On its course to the Deerfield River (Segment 33-01), it receives flows from Shippee Brook, Rice Brook, County Brook, Taylor Brook, and Steele Brook.

MA DFWELE has recommended that Pelham Brook and several tributaries in its subwatershed - Tuttle, Potter, Shippee, County, Taylor and Steele brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in the subwatershed of this segment; Rowe Brush Dump and Rowe Landfill. The Rowe Brush Dump is over 25 years old and is not lined or capped. It received demolition debris and lies within 100 feet of Pelham Brook. It was not recommended for screening level sampling as part of the Fuss and O'Neill study. The Rowe landfill received municipal waste and is also over 25 years old. It is not lined or capped and is within 100 feet of Pelham Brook. As part of the project screening level sampling was conducted in 2003 from a downgradient groundwater seep. No adverse water quality impacts were detected.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
Pelham Brook was sampled by DWM near the mouth of the brook upstream from Rowe Road, Charlemont (Station PB01) in September 2000. At the time of the survey the brook was roughly 7 m wide with depths ranging from 0.2 m to 0.75 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 187 (Appendix B). Both banks were well-vegetated and the forested riparian zone provided ample stream shading. The instream habitat provided a variety of velocity conditions.

Biology
Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was non-impacted in Pelham Brook 200 m upstream from Rowe Road, Charlemont (Station PB01) in September 2000 (Appendix B). Fish species captured in order of abundance included: slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinichthys cataractae*), Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), and brown trout (*Salmo trutta*) (Appendix B). Four of the species collected are considered to be intolerant of pollution. In addition to these species, longnose sucker (*Catostomus catostomus*) (an intolerant

species) were documented in Pelham Brook in Rowe by MA DFWELE in August 2000 and September 2001. Their sampling also documented multiple age classes of both Atlantic salmon and brook trout (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions, as well as stable flow regimes.

<u>Chemistry-water</u>
DWM collected water quality samples from Pelham Brook just upstream from the bridge off Zoar Road in Charlemont (Station PE) in November and December 1995 and April 1996 (Appendix G, Table G4).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis and fish population information.

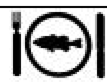
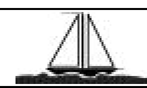
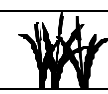
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Pelham Brook just upstream from the bridge off Zoar Road in Charlemont (Station PE) in November and December 1995 and April 1996 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in Pelham Brook in September 2000 (Appendix B).

Although too limited bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

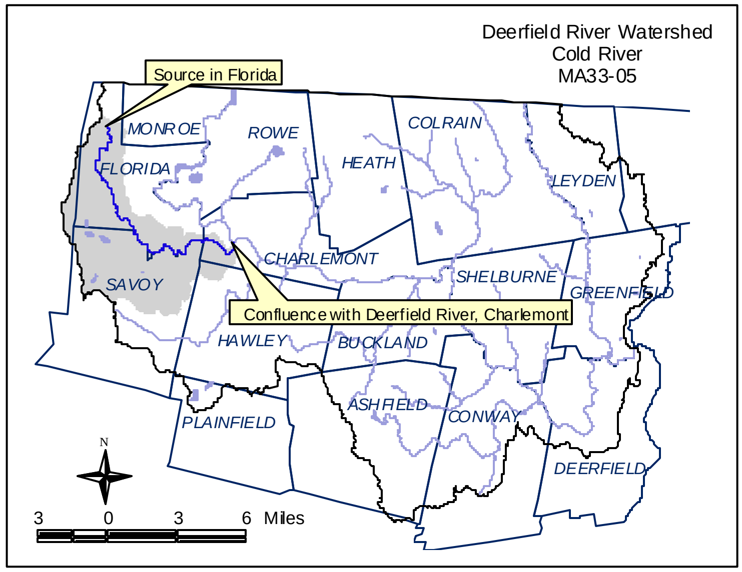
Pelham Brook (MA33-12) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS PELHAM BROOK (MA33-12)

- Continue to perform DWM water quality and biological monitoring of this segment during the next monitoring year cycle (2005).
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- Pelham Brook and several tributaries in its subwatershed - Tuttle, Potter, Shippee, County, Taylor and Steele brooks - should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of Rowe Landfill along Pelham Brook, including: removal of solid waste from Pelham Brook, cleanup of refuse along the base of the landfill, and repair and stabilization of the eroded areas of the landfill side slopes. Additional field investigation may be warranted to further assess the environmental risk posed by the landfill and determine the need for corrective/remedial action.
- The Towns of Rowe and Charlemont should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Pelham Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Rowe and Charlemont should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

COLD RIVER (SEGMENT MA33-05)
Location: Source in Florida to confluence with Deerfield River, Charlemont.
Segment Length: 13.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 31.68 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	93.1%
Residential	2.3%
Agriculture	2.2%

The Cold River forms on the eastern flanks of the Hoosac Range in the Town of Florida. The river flows south under Route 2 and then changes course to the southeast until its confluence with Gulf Brook in Savoy. From this point it parallels Route 2 flowing eastward, passing through the Mohawk Trail State Forest, to its confluence with the Deerfield River in Charlemont. For most of its length the river is a high gradient stream flowing in a narrow valley.

MA DFWELE has recommended that the Cold River and several tributaries in its subwatershed - Green River, Tower, Gulf, and Manning brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in the watershed of this segment - the Savoy Mt. State Forest Brush Landfill. This landfill is over 25 years old and is not capped or lined. Since it received only wood waste and was previously investigated by MA DEP in 1998, it was not recommended for screening level sampling as part of this study. The 1998 study found no evidence of contamination at the site. The landowner (MA DCR) has removed visible refuse from the site and further dumping has been prohibited.

USE ASSESSMENT
AQUATIC LIFE
<u>Habitat and Flow</u>
The Cold River was sampled by DWM upstream from Trout Brook, in Charlemont, MA (Station CR01) in September 2000. At the time of the survey the brook was roughly 14 m wide with depths ranging from 0.3 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 178 (Appendix B). Instream vegetation was lacking, except for a thin film of filamentous algae. Stream banks were well vegetated, as was the forested riparian zone.

DWM biologists collected periphyton samples from Station CR01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 0% and percent algal cover was 60%. The dominant algal type and form was greens/filamentous-thin film. No nuisance algal growth was documented.

Flow in this subwatershed is unrestricted. With no impoundments and steep relief the river levels can rise and fall quickly in response to localized precipitation. Known as a "steep creek" to the local paddling community, the river's water level is too low to paddle except during spring run-off and during large thunderstorms (Mitchell 2003).

Biology

The benthic sample collected by DWM from the Cold River upstream from Trout Brook in Charlemont, MA (Station CR01) in September 2000 was used as the reference station condition for the 2000 Deerfield River Watershed Biomonitoring Survey (Appendix B). Given its status as a reference station the benthic community was considered to be non-impacted. Macroinvertebrate biomonitoring was also conducted in the Cold River upstream from the confluence with the Deerfield River in 1988 (Appendix C). Fish species captured in order of abundance included Atlantic salmon (*Salmo salar*), blacknose dace (*Rhinichthys atratulus*) longnose dace (*Rhinichthys cataractae*), and a brown trout (*Salmo trutta*) (Appendix B). Two of the species collected are considered to be intolerant of pollution. In addition to these species, slimy sculpin (*Cottus cognatus*) and rainbow trout (*Onchorynchus mykiss*) (both intolerant species) were documented in the Cold River by MA DFWELE in either August 2000 and/or September 2001. Their sampling also documented multiple age classes of Atlantic salmon (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water

DWM collected water quality samples from the Cold River at the bridge to the Mohawk Forest State Campground in Florida (Station CO) between September 1995 and June 1996 (n = 8 sampling events; Appendix G, tables G3 and G4). The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment in the Cold River downstream from Mohawk Trail State Forest – near the confluence with Trout Brook (COR-010). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not included in this assessment (DRWA 2001and DRWA 2002).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community (reference station) and fish population information.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION

Fecal coliform bacteria sampling was conducted by the DRWA in the Cold River downstream from Mohawk State Forest in Charlemont (Station COR-010) between June and August 2001 and 2002 (n = 11 sampling events). Fecal coliform counts at this station ranged from 0 to 200 colonies/100 mL during both dry and wet weather sampling events (DRWA 2001 and DRWA 2002).

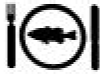
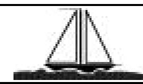
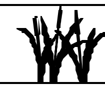
DWM collected water quality samples from the Cold River at the bridge to the Mohawk Forest State Campground in Florida (Station CO) between September 1995 and June 1996 (n = 8 sampling events; Appendix G, Table G4).

It should be noted that MA DCR owns and operates the Mohawk State Park in the Town of Charlemont. This park has a swimming area formed by a diversion from the Cold River. The MA DCR monitors the coliform levels in this swimming area, which is not on the Cold River proper. This bathing area was closed for two days (31 July to 1 August 2002) due to elevated *Enterococci* levels. The bathing area closed again on 6 August 2002 throughout the remainder of the swimming season due to elevated *Enterococci* levels.

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in the Cold River in September 2000 (Appendix B).

Based on the low fecal coliform bacteria data and the excellent aesthetic conditions the *Recreational* and *Aesthetics Uses* are assessed as support.

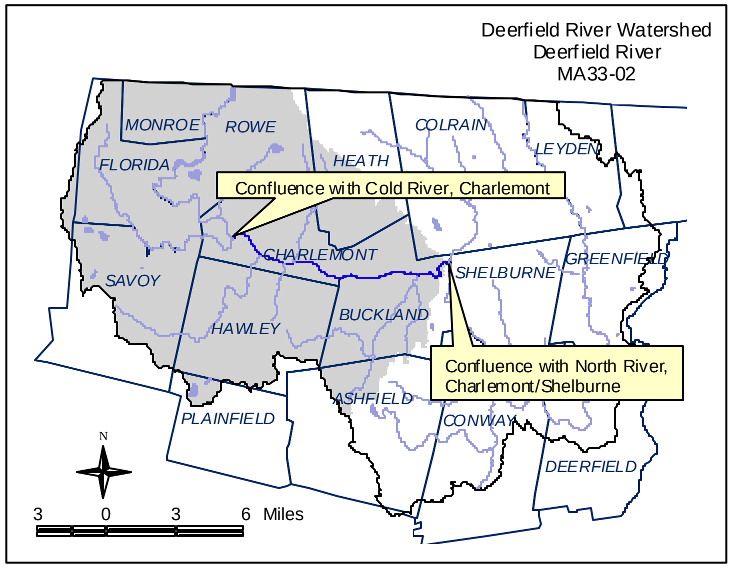
Cold River (MA33-05) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

RECOMMENDATIONS COLD RIVER (MA33-05)

- Continue to perform DWM water quality and biological monitoring to protect the high water quality of this segment during the next monitoring year cycle (2005). As a reference station, biomonitoring is recommended here in 2005 especially if evaluations of third to fifth-order stream biota are planned. Fish population sampling using multiple crews or a barge-mounted electrofishing unit should accompany the macroinvertebrate sampling effort.
- The Cold River and several tributaries in its subwatershed - Green River, Tower, Gulf, and Manning brooks - should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- The Towns of Charlemont, Florida, and Savoy should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Cold River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Charlemont, Savoy and Florida should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The results of the volunteer monitoring surveys to locate and map locations of Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Tannery Brook subwatershed should be consulted to help prevent or control future infestations of this invasive in this subwatershed (Serrentino 2003). This was the only Deerfield subwatershed surveyed during this project that volunteers did not find Japanese knotweed. Efforts should be made to continue to monitor this subwatershed for this invasive plant and implement control measures if it is found.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.

DEERFIELD RIVER (SEGMENT MA33-02)
Location: Confluence with Cold River, Charlemont to confluence with North River, Charlemont/Shelburne.
Segment Length: 11.4 miles.
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 169.66 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.3%
Residential	2.6%
Agriculture	4.8%

This segment is on the 1998 303(d) List of Waters needing confirmation for unknown toxicity, metals, and chlorine (Table 2).

From the confluence with the Cold River in Charlemont the Deerfield River flows about a mile and a half before being joined by the Chickley River in Charlemont. Approximately one mile below Charlemont Center the river becomes the boundary between Buckland and Charlemont flowing east about four miles through a fairly broad valley. As the river passes under Route 2 it turns north flowing over a hydroelectric dam (Deerfield No.4) and is joined at the top of its northward loop by the North River at the border of Charlemont, Buckland and Shelburne. This confluence marks the end of this segment.

MA DFWELE has recommended that 12 tributaries to this segment of the Deerfield River be protected as cold water fishery habitat (Legate Hill, Bozrah, Rice, Mill and its tributaries Heath and Maxwell, Albee, First, Second, Third, Wilder, and East Oxbow brooks) (MassWildlife 2001).

The Natural Heritage and Endangered Species Program has certified one vernal pool in this subwatershed (MassGIS 1999).

WMA WATER WITHDRAWAL SUMMARY
Based on available data there are no regulated water withdrawals from this segment.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H2 AND H3)
The Town of Charlemont is authorized to discharge from the Charlemont Wastewater Treatment Plant (WWTP) to the Deerfield River just downstream from the confluence of Mill Brook (off Route 2) in Charlemont (NPDES permit MA0103101, issued February 2004). The permittee is authorized to discharge 0.05 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes ultraviolet light for disinfection. A facility upgrade (improvement of sand filter beds) was completed in the winter of 1999 (Peters 2003).

OTHER
Hydropower (Federal Energy Regulatory Commission - FERC)
The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of one FERC licensed project (FERC L.P. No. 2323, owned by USGenNE), which was reissued April 1997 (Appendix H, Table H3).

- The Deerfield No. 4 Development is located on the Deerfield River approximately 0.9 miles upstream from the confluence with the North River in Buckland/Charlemont. This development includes a concrete dam 160 feet long, 50 feet high with six 8 feet high wooden flashboards that can impound a surface area of about 75 acres and approximately 2 river miles (FERC 1997). There is a 241' long concrete gravity spillway. This development has a power tunnel that conveys water from the intake structure at the impoundment via a 12.5-foot diameter, 1,514 feet long concrete and brick-lined horseshoe shaped tunnel to the powerhouse. The powerhouse contains three horizontal Francis turbine units with a capacity of 1,600 kw each, and a total hydraulic capacity of 1,490 cfs. (FERC 1997). The power canal tunnel cuts through a bend in the river, which bypasses approximately 1.4 miles of the Deerfield River (the lower 0.9 miles of this segment and the upper 0.5 miles of segment MA33-03). A minimum flow of 100 cfs or inflow, whichever is less is required from 1 October to 31 May and 125 cfs or inflow, whichever is less is required from 1 June to 30 September at this development. Downstream fish passage was required at the Deerfield No. 4 project in the April 1997 FERC license for Project 2323. A 60 cfs release from 1 April to 15 June and 15 September to 15 November is required for downstream smolt passage. This downstream smolt passage flow is not in addition to minimum instream flow requirements.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Heath/Hawley/Charlemont Landfill (Three Town Landfill). This landfill received municipal solid waste from households, farms and commercial establishments for over 25 years and is not capped or lined. The site is within one-half mile of private water supplies and less than 500 feet from a surface receiving water. Environmental monitoring has been conducted here since 1987 so screening level sampling was not recommended at this site as part of this study. The three towns are currently evaluating impacts of this landfill on nearby private wells and other downstream receptors and plans are being discussed to properly cap the site.

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

According to USGS (information from gaging station on the Deerfield River near Charlemont - 01168500) flows have been regulated by Somerset Reservoir, Harriman Reservoir, and by several powerplants upstream. The drainage area at this gage is 361 mi^2. Data from the USGS gage revealed that the 2000 water year annual mean flow (1,137 cfs) was greater than the mean annual flow for the 87-year period of record (903 cfs) (Socolow *et al*. 2001). The estimated 7Q10 flow at the gage is 66.4 cfs (USGS 2003).

The 1997 FERC license for the Deerfield Project Number 2323 at the Deerfield No. 4 Station currently requires a minimum flow from the dam to the mainstem Deerfield River of 100 cfs or inflow, whichever is less from October 1 to May 31. During June 1 to September 30 minimum flow required from this dam is 125 cfs or inflow, whichever is less (FERC 1997). The turbine capacity at the Deerfield No. 4 Station development is variable up to 1,490 cfs (total of the three generators). Downstream fish passage at this development is also required with a 60 cfs release from 1 April to 15 June and from 15 September to 15 November for downstream smolt passage.

Biology

Macroinvertebrate biomonitoring was conducted in the Deerfield River near the USGS gage in Charlemont (Station LDR02) in 1988 (Appendix C). A screening survey (RBP I) was also conducted in August 1999 by DWM biologists in response to a request from the Deerfield River Watershed Team and the MA DEP WERO to evaluate any gross impact in the Deerfield River resulting from a train derailment accident that spilled latex into the Deerfield River in Charlemont. No gross impairment to the benthic community was observed and more than half of the taxa collected were comprised of pollution intolerant EPT orders (Fiorentino 1999). No recent RBP III level data have been collected from this segment of the Deerfield River.

Toxicity

Ambient

Water from this segment of the Deerfield River was collected approximately 100 to 1000 feet upstream from the Charlemont WWTF discharge for use in their whole effluent toxicity tests. Between January 1996 and August 2002 survival of Ceriodaphnia dubia and Pimephales promelas exposed (48-hour) to the river water ranged between 20 to 100% and 75 to 100%, respectively. Survival of C. dubia was less than 75% during one of the nine test events (January 1996 test) and has not been less than 90% since.

Effluent
Nine definitive acute whole effluent toxicity tests were conducted on the Charlemont WWTF effluent using *C. dubia* and *P. promelas* between January 1996 and August 2002. The effluent was acutely toxic (LC_{50} = 60.85% effluent) to *C. dubia* during one of the eight valid test events and acutely toxic (LC_{50} = 60. 5 and 70.7% effluent) to *P. promelas* during two of the eight valid test events, all of which occurred prior to the facility upgrade, which was completed in the winter of 1999. The discharge was, however, in compliance with the permit's whole effluent toxicity limit of $LC_{50} \geq$ 50% effluent. Effluent quality at the facility in terms of both ammonia-nitrogen and whole effluent toxicity has improved since the facility upgrade.

<u>Chemistry - Water</u>
Deerfield River water was collected approximately 100 to 1000 feet upstream from the Charlemont WWTF discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on nine occasions between January 1996 and August 2002. Data from these reports, which are maintained in the TOXTD database by DWM, were summarized for this period. Water quality sampling was also conducted by DWM on the Deerfield River near the USGS gage 01168500 in Charlemont (Station DR03) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9).

Water quality samples were also collected from the Deerfield River near the USGS gage in Charlemont (Station DW2) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment of the Deerfield River at two stations: downstream from the Charlemont WWTP discharge (DER-021) and at "Old Willow", above the Stillwater Restaurant in Charlemont, MA (DER-020). Samples were collected for pH, D.O., alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

DO and % saturation
DO in the Deerfield River near the USGS gage in Charlemont (Station DR03 and DW2) measured by DWM and ESS in 2000 ranged from 9.3 to 12.77 mg/L and saturation was not less than 91% during the sampling events conducted. It should be noted that these data represent both worst-case (per-dawn) and daytime conditions.

Temperature
The maximum temperature in this segment of the Deerfield River recorded by DWM and ESS in 2000 in the Deerfield River was 19.7°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the Deerfield River upstream from the Charlemont WWTF discharge (recorded in the TOXTD database between January 1996 and August 2002) ranged between 6.1 and 7.2 SU and one of the 10 measurements (10%) reported was less than 6.5 SU. Alkalinity recorded in the TOXTD database ranged from 10 to 40 mg/L. The pH of the Deerfield River (Station DR03) reported by DWM and ESS ranged from 6.4 to 6.8 SU and alkalinity was low (4 to 6 mg/L - qualified data excluded; Appendix A, Tables A8 and A9 and ESS 2002).

Specific Conductance
Conductivity measurements in the Deerfield River upstream from the Charlemont WWTF discharge (recorded in the TOXTD database between January 1996 and August 2002) ranged between 42 and 160 µS/cm. Measurements in the river near the USGS gage in Charlemont (Station DR03) ranged from 87.1 to 101 µS/cm (Appendix A, Table A8).

Suspended Solids
Suspended solids measurements in the Deerfield River (station DR03) were very low; ranging between 1.4 to 1.9 mg/L (Appendix A, Table A9).

Turbidity
Measurements for turbidity in the Deerfield River (Stations DR03 and DW2) were very low; ranging between 0.15 to 1.7 mg/L NTU (qualified data excluded; Appendix A, Table A9 and ESS 2002).

Ammonia-Nitrogen
The concentration of ammonia-nitrogen recorded in the TOXTD database from samples collected upstream from the Charlemont WWTF (between January 1996 and August 2002) ranged from 0.02 to 0.11mg/L. No detectable concentrations of ammonia-nitrogen were documented by DWM in the Deerfield River (Station DR03) in the summer of 2000 (Appendix A, Table A9).

Nitrate-Nitrogen
Measurements for nitrate-nitrogen in the Deerfield River (Station DR03) ranged from 0.10 to 0.12 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measured by DWM in the Deerfield River (Station DR03) ranged from <0.010 to 0.014 mg/L (Appendix A, Table A9).

Total Residual Chlorine
The maximum reported TRC measurement for this segment of the Deerfield River (recorded in the TOXTD database upstream from the Charlemont WWTF between January 1996 and August 2002) was 0.06mg/L. With the exception of this one measurement all of the other nine measurements were below the minimum quantification level of 0.05 mg/L.

Hardness
Hardness reported for this segment of the Deerfield River (recorded in the TOXTD database upstream from the Charlemont WWTF between January 1996 and August 2002) ranged between 8 and 36 mg/L. Hardness measured by DWM in the Deerfield River (Station DR03) ranged from 8.9 to 10 mg/L (Appendix A, Table A9; qualified data excluded).

<u>Chemistry – sediment</u>
Three sediment grab samples were collected and composited from behind the Deerfield No. 4 impoundment on the Deerfield River (Station DWS-2) in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAHs (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), total organic carbon (TOC), percent volatile solids, percent water, and grain size. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud *et al*. (1993). The arsenic concentration was measured at 12.0 ppm, which is approximately two times greater than the L-EL. The sediment was comprised primarily of medium sand (82%). No PAH, TPH, volatile solids or PCB were detected.

The *Aquatic Life Use* is assessed as support based on the generally good survival of test organisms exposed to the Deerfield River and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users' observations regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2001, 2002, 2003 and 2004). It is USGen New England, Inc.'s first priority to continue to operate hydropower facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation. The concentration of arsenic in the sediment sample collected behind the Deerfield No. 4 dam in this segment of the Deerfield River was also slightly elevated, but is due likely to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002).

PRIMARY AND SECONDARY CONTACT RECREATION

Fecal coliform bacteria samples were collected from the Deerfield River near the USGS gage in Charlemont (Station DW2) on six occasions (during three dry and three wet weather events) between August and November 2000 by ESS (ESS 2002). Four of these sampling events occurred during the *Primary Contact Recreational* season. Fecal coliform counts at this sampling location ranged from 10 to 50 colonies/100 mL.

This segment of the Deerfield River flows through small towns and agricultural areas and attracts a large number of visitors (for boating, fishing, hiking, picnicking, swimming, sightseeing) mainly during the spring, summer, and fall. The river was clear (turbidity and suspended solids data were very low and no objectionable deposits, odors, or oil sheens were reported (Appendix A, Tables A8 and A9 and ESS 2002).

The *Recreational* and *Aesthetics* uses are assessed as support for this segment of the Deerfield River based on the low fecal coliform bacteria counts and the aesthetic conditions.

Deerfield River (MA33-02) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT*	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

*Alert Status issues identified, see details in the use assessment section if necessary

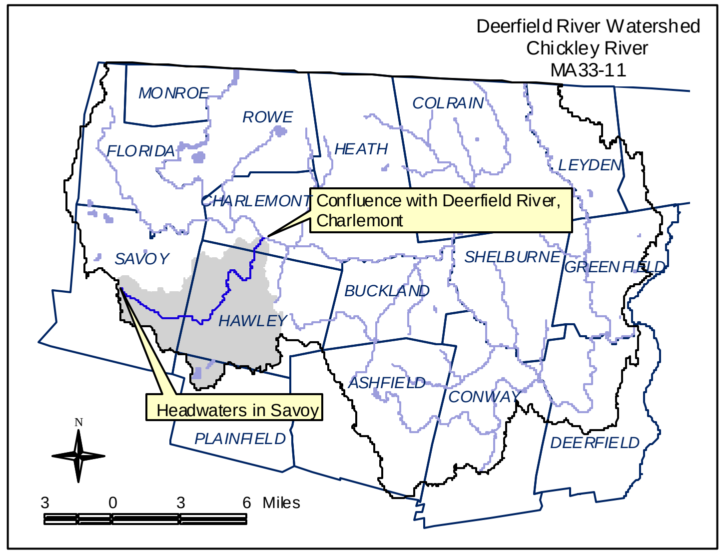
RECOMMENDATIONS DEERFIELD RIVER (MA33-02)

- Continue to perform DWM water quality and biological monitoring in this segment during the next monitoring year cycle (2005).
- Biological surveys designed to assess impacts of hydroregulation on aquatic biota would be useful to investigate concerns voiced by members of the Deerfield Watershed Team that habitat and benthic macroinvertebrates downstream from power station dams may be affected by frequent water level changes and rapid ramping rates that result from hydropower production.
- Evaluate the possibility of removing this segment from the 303d List since the WWTP has been improved and NPDES monitoring data indicate improvement over 1995 data.
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, Zoar Outdoor and Trout Unlimited.
- Work with NRCS, DFA and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The Towns of Charlemont, Buckland, Florida, Savoy, Hawley, Heath, Rowe, and Monroe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Buckland, Florida, Savoy, Hawley, Heath, Rowe, and Monroe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and

habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

- The results of the volunteer monitoring surveys to locate and map Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Avery Brook subwatershed should be consulted to help manage infestations of this invasive plant in this subwatershed (Serrentino 2003). In addition, encourage work by the DRWA, other local groups and agencies, and the power company to address invasive Japanese knotweed already well established along mainstem in this segment.
- Based on MA DFWELE recommendations, the following 12 tributaries to this segment of the Deerfield River should be protected as cold water fishery habitat (Legate Hill, Bozrah, Rice, Mill and its tributaries Heath and Maxwell, Albee, First, Second, Third, Wilder, and East Oxbow Brooks).

CHICKLEY RIVER (SEGMENT MA33-11)
Location: Headwaters, Savoy Mountain State Forest, Savoy, to confluence with Deerfield River, Charlemont.
Segment Length: 11.1 miles.
Classification: Class B.



The drainage area of this segment is approximately 27.41 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	92.8%
Agriculture	3.5%
Residential	1.6%

This segment is on the 1998 303(d) List of Waters needing confirmation for pathogens (Table 2).

The headwaters of the Chickley River begin on the southeastern slopes of Borden Mountain in the Savoy Mountain State Forest in Savoy. The river flows in an easterly direction as a high gradient stream until it reaches West Hawley where it changes direction to the north. Here the gradient lessens and there is some flood plain development, which has allowed some agricultural development in the river valley. From West Hawley the river parallels Route 8A to its confluence with the Deerfield River in Charlemont.

MA DFWELE has recommended that the Chickley River and the following tributaries in its subwatershed - Basin, King, North, and Mill brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Savoy Landfill. This site is over 25 years old and is not capped and is partially lined. It underwent MA DEP closure in the early 1990s. The site contains municipal waste and lies within 0.8 miles of a public water supply and 1,000 feet from Tilton Brook in this subwatershed. Screening level sampling was not recommended for this site as part of the study.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
The Chickley River was sampled by DWM 900 m upstream from its confluence with the Deerfield River in Charlemont (Station CH01) in September 2000. At the time of the survey the river was roughly 12 m wide with depths ranging from 0.1 m to 0.9 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 163 (Appendix B). Habitat quality was limited most by sedimentation and bank erosion and the marginal channel flow status (between 25 and 75% of the stream channel was filled with water). Aquatic vegetation was absent in the primarily open canopied stream reach and algal growth was minimal (small patches of filamentous green forms on rock substrates).

DWM biologists collected periphyton samples from Station CH01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 1% and percent algal cover was <1%. The predominant algal types and forms were greens/diatoms/filamentous. No nuisance algal growth was documented.

Biology

Compared to both the Cold River reference station (Station CR01) and the Bear River reference station (VP11BEA), the RBP III analyses indicated the benthic community was slightly impacted in the Chickley River 900 m upstream from the confluence with the Deerfield River, Charlemont (Station CH01) in September 2000 (Appendix B). Although the fish sampling efficiency was rated as poor (sampling was limited by deep pools, fast-moving deep runs, and heavy downpours, which limited both visibility and accessibility) fish species captured in order of abundance included Atlantic salmon (*Salmo salar),* slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinichthys cataractae*), blacknose dace (*Rhinichthys atratulus*), brown trout (*Salmo trutta*) and rainbow trout (*Onchorynchus mykiss)* (Appendix B). Four of the species collected are considered to be intolerant of pollution. Although the fish sampling efficiency was poor all fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry – water

Water quality sampling was conducted by DWM in the Chickley River at the bridge on Tower Road in Charlemont (Station CH) in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This location was also sampled by DWM between September 1995 and June 1996 (n = 10 sampling events) (Appendix G, Tables G3 and G4). Additionally, five locations upstream from the main sampling station (Stations CH2, CH3, CH4, CH5, and CH7) were sampled on 27 September 1995.

DO

DO in the Chickley River at Station CH ranged from 9.3 to 11.6 mg/L and saturation was not less than 90% on the three sampling events conducted in the summer of 2000. It should be noted that these data represent the worst-case (pre-dawn) conditions.

Temperature

The maximum temperature in the Chickley River was 15.8°C.

pH

Instream pH ranged between 6.9 and 7.2 SU

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis, the fish population information and the limited recent water quality data.

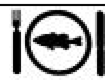
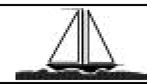
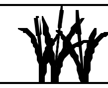
PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from the Chickley River at the bridge on Tower Road in Charlemont (Station CH) between September 1995 and June 1996 (n = 10 sampling events) (Appendix G, Table G4). Five additional locations upstream from the main sampling station (Stations CH2, CH3, CH4, CH5, and CH7) were also sampled on 27 September 1995 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in the Chickley River in September 2000 (Appendix B).

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

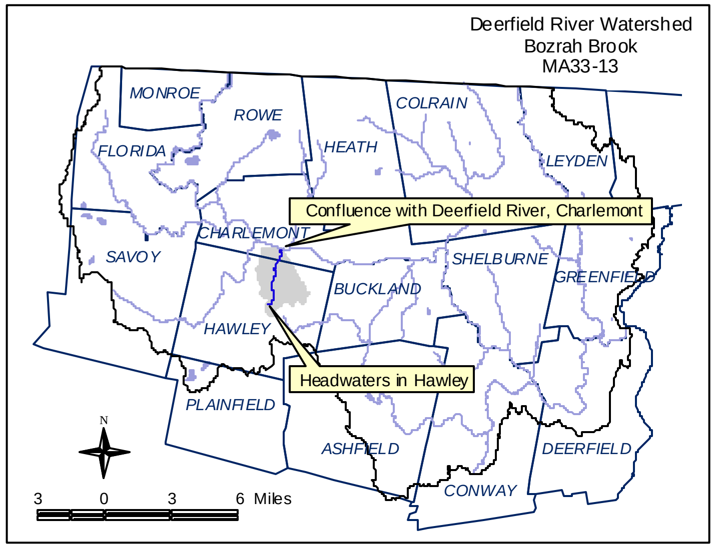
Chickley River (MA33-11) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS CHICKLEY RIVER (MA33-11)

- Continue to perform DWM water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, biomonitoring and fish population sampling are recommended here in 2005. Fish population assessments should be conducted using multiple crews or a barge-mounted electrofishing unit. In addition, water quality monitoring throughout the Chickley River subwatershed, especially nutrient and bacteria sampling, may help to isolate sources of nutrient/organic loads.
- Based on MA DFWELE recommendations, the Chickley River and the following tributaries in its subwatershed - Basin, King, North, and Mill brooks - should be protected as cold water fishery habitat.
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- The Towns of Charlemont, Hawley, Plainfield, and Savoy should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Chickley River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Hawley, Plainfield, and Savoy should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- Work with NRCS, DFA and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices as described in Unpaved Roads BMP Manual (BRPC 2001) should then be encouraged, as appropriate.
- The results of the volunteer monitoring surveys to locate and map Japanese knotweed stands conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Chickley River subwatershed should be consulted to help manage current and future infestations of this invasive plant which was found to be well established between West Hawley and Forge Hill (Serrentino 2003).

BOZRAH BROOK (SEGMENT MA33-13)
Location: Headwaters, located west of East Hawley Road, Hawley (drains wetland), to confluence with Deerfield River, Charlemont.
Segment Length: 3.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 4.15 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	84.3%
Open Land	7.3%
Agriculture	5.2%

Bozrah Brook forms in the Town of Hawley and flows north down steep terrain until it flows by the Berkshire East Ski Area where the gradient lessens. It then enters an area of highly erodible soils before its confluence with the Deerfield River in Charlemont.

The Natural Heritage and Endangered Species Program has certified three vernal pools in this subwatershed (MassGIS 1999).

MA DFWELE has recommended that Bozrah Brook be protected as a cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Chemistry-water

DWM collected water quality samples from Bozrah Brook off of South River Road near the Berkshire East Ski Area in Charlemont (Station BO) in September, November and December 1995 and April 1996 (Appendix G, Tables G3 and G4).

Too limited data are available so the *Aquatic Life Use* is not assessed for Bozrah Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Bozrah Brook off of South River Road near the Berkshire East Ski Area in Charlemont (Station BO) in September, November and December 1995 and April 1996 (Appendix G, Table G4). It should also be noted that DWM field crews noted erosion, siltation and the dumping of building materials along the banks in lower Bozrah Brook during the 1995/1996 surveys.

Too limited data are available so the *Recreational* and *Aesthetics* uses are not assessed for Bozrah Brook. However, the *Aesthetics Use* is identified with an Alert Status because of the historic reported dumping of building materials.

Bozrah Brook (MA33-13) Use Summary Table

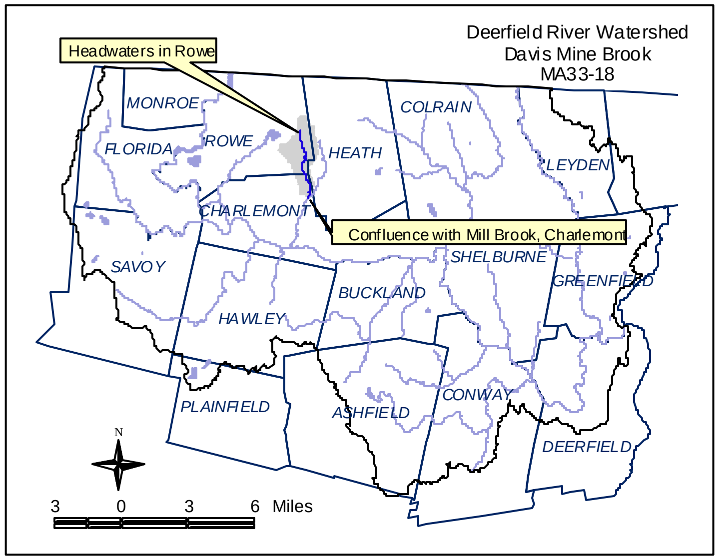
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED*

*Alert Status issues identified, see details in the use assessment section if necessary

RECOMMENDATIONS BOZRAH BROOK (MA33-13)

- Conduct water quality and biological monitoring in this segment to more completely assess the designated uses during the next monitoring year cycle (2005). In particular, evaluate the extent and impact of observed dumping, siltation, and erosion on biota and habitat quality.
- Based on MA DFWELE recommendations, Bozrah Brook should be protected as a cold water fishery habitat.
- The Towns of Charlemont and Hawley should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Bozrah Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Charlemont and Hawley should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

DAVIS MINE BROOK (SEGMENT MA33-18)
Location: Headwaters, just south of Dell Road, Rowe, to confluence with Mill Brook, Charlemont.
Segment Length: 3.3 miles
Classification: Class B.



The drainage area of this segment is approximately 3.11 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	91.3%
Agriculture	5.0%
Open land and Residential	1.5% each

This segment is on the 1998 303(d) List of Waters needing confirmation for pH and other habitat alterations (Table 2).

The headwaters of Davis Mine Brook originate just south of the intersection of Dell Road and Cyrus Stage Road in Rowe. The brook flows in a southerly direction through steep terrain and passes just east of the old Davis Mine where runoff from the mine is flowing into it. The brook then enters into Charlemont where it flows into a steep valley until it reaches the confluence with Mill Brook in Charlemont.

The University of Massachusetts, Department of Geosciences, is currently conducting a five year study funded by the National Science Foundation to characterize the old Davis Mine site in detail and examine the processes of natural attenuation of acid mine drainage through field studies, modeling, and laboratory experiments, and to quantify the roles of acidophilic and acid-tolerant anaerobic microorganisms (Yuretich, *et al*. in preparation).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow
Davis Mine Brook was sampled by DWM upstream from its confluence with Mill Brook in Charlemont (Station DM00) in September 2000. At the time of the survey the river was roughly 4 m wide with depths ranging from 0.1 m to 0.5 m. The substrates in this very high-gradient system were comprised primarily of boulders and cobble material that appeared reddish in color (probably the result of ferric inputs from upstream mining activities). The overall habitat score was 174 (Appendix B). The riparian zone was heavily forested along the right bank but was disturbed on the left bank (long-term disposal site).

DWM biologists collected periphyton samples from Station DM00 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% and percent algal cover was <5%. The dominant algal type and form was greens/mat. No nuisance algal growth was documented (Appendix D).

Biology
Too few macroinvertebrates were collected in Davis Mine Brook, although the instream habitat was adequate to support a sound community. Therefore, the RBP III analysis could not be calculated (Appendix B). Despite adequate fish habitat and extensive sampling effort, no fish were collected from Davis Mine Brook. It does appear that acidic mine drainage has eliminated fish and many invertebrates from this stream (Appendix B).

Chemistry-water
Water quality sampling was conducted by DWM in the Davis Mine Brook system in July 1996 (Stations DMB-1, UKN, DMB-2, and DMB-B)). The effects of acid mine drainage on pH were evident from the low (3.7) pH reading in the brook below the drainage from the mine (Appendix G, Table G3).

The *Aquatic Life Use* for Davis Mine Brook is assessed as impaired based on the depauperate benthic macroinvertebrate community and the lack of fish. The effects of acid mine drainage (from the abandoned Davis Mine) is responsible for the poor state of macroinvertebrate and fish community health.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS
Although no bacteria data are available, the *Recreational Uses* are assessed as impaired in the lower 1.7 miles because of objectionable deposits in this section of Davis Mine Brook. These uses are not assessed for the upper 1.6 miles of Davis Mine Brook.

Although no oils, turbidity nor odors were observed/detected, objectionable deposits of ferric (iron) oxides were noted during the biological monitoring survey conducted by DWM biologists in Davis Mine Brook in September 2000 (Appendix B). A large auto/junk yard also extended along the left bank of the brook although no obvious impacts from this area to the brook were observed.

The *Aesthetics Use* is not assessed in the upper 1.6 miles of Davis Mine Brook. This use is assessed as impaired in the lower 1.7 miles because of objectionable deposits/precipitate on the streambed that results from the acid mine drainage.

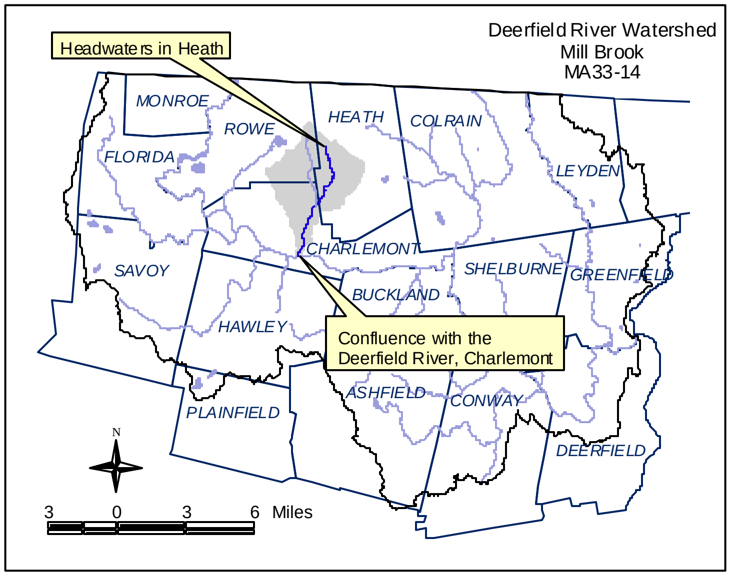
Davis Mine Brook (MA33-18) Use Summary Table

Designated Uses		Status	Causes	Sources
Aquatic Life		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Benthic macroinvertebrate bioassessment, fishes bioassessments (streams), and pH	Acid Mine Drainage
Fish Consumption		NOT ASSESSED		
Primary Contact		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Iron	Acid Mine Drainage
Secondary Contact		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Iron	Acid Mine Drainage
Aesthetics		NOT ASSESSED upper 1.6 miles IMPAIRED lower 1.7 miles	Combined biota/habitat bioassessment (streams), and Iron	Acid Mine Drainage

RECOMMENDATIONS DAVIS MINE BROOK (MA33-18)

- Continue to conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, coordinate sampling effort with ongoing University of Massachusetts, Department of Geosciences study at this site. When the results of this National Science Foundation funded study are available (expected in 2005/2006) (Yuretich, *et al.* in preparation) a Section 319 grant should be pursued for remediation of the acid mine drainage. In addition, the Franklin County NRCS field office has offered to request assistance from their Interdisciplinary Research Team (IRT) for BMP recommendations and conceptual design ideas for acid mine drainage remediation.
- The Towns of Charlemont and Rowe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent further degradation of water quality in the Davis Mine Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont and Rowe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.

MILL BROOK (SEGMENT MA33-14)
Location: Headwaters, originating north of Rowe Road, Heath, to confluence with the Deerfield River, Charlemont.
Segment Length: 5.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 11.94 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.3%
Agriculture	6.3%
Residential	2.9%

The headwaters of Mill Brook form in the Town of Heath and flow south through a steep, narrow valley that parallels Route 8A. Davis Mine Brook enters Mill Brook just south of the Charlemont border. Mill Brook flows southwest and then flows into an impounded area formed by a partially breached dam. The brook continues into Charlemont Center crossing under Route 2 before its confluence with the Deerfield River in Charlemont.

MA DFWELE has recommended that Mill Brook and Maxwell Brook, a tributary to Mill Brook, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in the watershed of this segment; the Charlemont Landfill and a former Town of Charlemont brush dump. The Charlemont landfill is over 25 years old and is not capped or lined. The site received municipal waste, is close to private water supplies, and is within 10 feet of Tatro Brook, a tributary to Mill Brook. This landfill was recommended for screening level sampling by Fuss and O'Neill (2003) due to its potential to impact sensitive environmental receptors, however, suitable sampling locations were not found so no samples were collected. The brush dump, located along Warner Hill Road, was discovered during field reconnaissance and no additional information was available from the Town on this dump.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow
Mill Brook was sampled by DWM downstream from Harris Mountain Road, Charlemont (Station MB01) in September 2000. At the time of the survey the brook was roughly 8 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulders and cobble. The overall habitat score was 181 (Appendix B). The steep banks within this reach exhibited some signs of erosion.

Biology
Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was slightly impacted in Mill Brook downstream from Harris Mountain Road, Charlemont (Station MB01) in September 2000 (Appendix B). Fish species captured in order of abundance included Atlantic salmon (*Salmo salar),* brook trout (*Salmo trutta*), and blacknose dace (*Rhinichthys atratulus*) (Appendix B). Two of the species collected are considered to be intolerant of

pollution. However, both the low number of fish collected and the absence of slimy sculpin and longnose dace were noted to be of concern given the available habitat quality in Mill Brook. MA DFWELE documented multiple age classes of both Atlantic salmon and brook trout in Mill Brook upstream from its confluence with Davis Mine Brook in August 2000 (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat quality and stable flow regimes.

<u>Chemistry-water</u>
DWM collected water quality samples in Mill Brook just upstream from its confluence with the Deerfield River in Charlemont (Station MI) in September, November and December 1995 and April 1996 (Appendix G, tables G3 and G4). Limited sampling was also conducted at an upstream location (Station MIL2 upstream from the covered bridge in Charlemont); from Heath Brook (a tributary to Mill Brook in August 1995, and upstream and downstream from the confluence with Davis Mine Brook (Stations MB-A and MB-B, respectively) (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* in Mill Brook is assessed as support based on the benthic macroinvertebrate community analysis and fish population information. However, this use is identified with an “Alert Status” because of the slightly impaired benthic community and the fish population survey results that reported a low number of fish collected as well as absence of slimy sculpin and longnose dace despite available suitable habitat (also see concerns in Appendix B). It is possible that some effects of the acid mine drainage from Davis Mine Brook may still be influencing the benthos in Mill Brook, but taxa most vulnerable to acidified conditions (e.g., scrapers, mayflies) were well represented in the Mill Brook sample. Other potential stressors to this system include the junkyard near the mouth of Davis Mine Brook and the old Charlemont Landfill. And, while much of the upper portion of the Mill Brook subwatershed is relatively undeveloped, other potential sources of anthropogenic perturbation may exist as well.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Mill just upstream of its confluence with the Deerfield River in Charlemont (Station MI) in September, November and December 1995 and April 1996. One sample was also collected by DWM from Mill Brook upstream from the covered bridge in Charlemont and Heath Brook in September 1995 (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring survey conducted by DWM biologists in Mill Brook in September 2000 (Appendix B).

Although no recent bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

Mill Brook (MA33-14) Use Summary Table

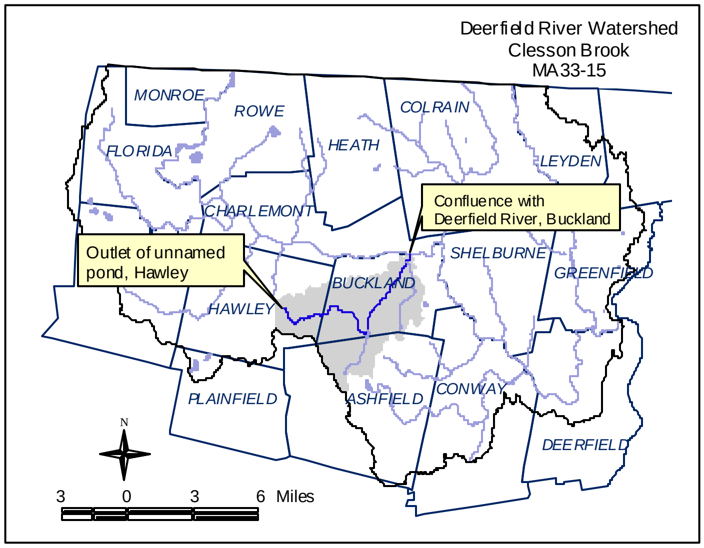
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS MILL BROOK (MA33-14)

- Since water quality, rather than habitat quality appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be helpful in determining the causes and sources of water quality degradation present here. In addition, biomonitoring and fish population sampling should be conducted by DWM in 2005.
- Based on MA DFWELE recommendations, Mill Brook and Maxwell Brook (a tributary to Mill Brook) should be protected as cold water fishery habitat.
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- The Towns of Charlemont, Heath and Rowe should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Mill Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Charlemont, Heath and Rowe should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of the Charlemont Landfill in the watershed of this segment, including removal of the exposed bulky waste on a steep slope adjacent to Tatro Brook, and for additional field investigation to further assess the environmental risk from the landfill and to determine the need for corrective/remedial action. Inspection and additional field investigation of the former municipal brush dump on Warner Hill Road is also recommended.

CLESSON BROOK (SEGMENT MA33-15)
Location: Outlet of unnamed pond south of Forget Road, Hawley through Cox Pond, to confluence with Deerfield River, Buckland.
Segment Length: 10.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 21.24 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	81.4%
Agriculture	9.6%
Open Land	4.7%

The headwaters of Clesson Brook begin at an unnamed pond in Hawley and then flow through Cox Pond. From the outlet of Cox Pond the brook flows easterly through steep terrain entering the Town of Buckland and then bends around Drake Hill to flow southeast until it reaches Buckland Four Corners. From here the brook flows northeast with a lower gradient and the floodplain widens, which allows for farming. The brook parallels Route 112 through Buckland until it reaches a small, unnamed impoundment where it joins Clark Brook. Clesson Brook then continues a short distance from the outlet to its confluence with the Deerfield River in Buckland.

NRCS provided best management practice guidance to selected land owners in the Clesson Brook subwatershed following DWM's 1995/1996 Deerfield River Watershed monitoring survey. Several agricultural BMPs were implemented in this subwatershed (Leone 1999).

The Natural Heritage and Endangered Species Program has certified five vernal pools in this subwatershed (MassGIS 1999).

MA DFWELE has recommended that Clesson Brook and several tributaries in its subwatershed - Cooley, Ruddock, and Sheperd brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Buckland Landfill. The Buckland Landfill is over 25 years old and received municipal, demolition, and industrial waste as well as sludge from Shelburne Falls WWTP. Fly ash and bottom ash were used as daily cover material. The landfill underwent MA DEP closure and capping in the late 1990s, but is not lined. Environmental monitoring has been conducted at this site since 1991, including an Initial Site Assessment, a Comprehensive Site Assessment, and post-closure monitoring. Since this site is already being monitored it was not recommended for screening level sampling by Fuss and O'Neill (2003).

USE ASSESSMENT
AQUATIC LIFE
<u>Habitat and Flow</u>
DWM biologists sampled one stream reach in Clesson Brook in September 1996 (Appendix G, Tables G3 and G4). The reach was located downstream from Hog Hollow Road off of the east side of Route 112 in Buckland (Station VP10CLE) and was surveyed as part of the MA DEP Biocriteria Development

Project. The left side of Clesson Brook is channelized and riprapped due to the adjacent Route 112. Periphyton was very abundant and covered approximately 50% of the reach (Appendix D). Instream cover was suboptimal. A horse farm was located on the right bank and impacted the riparian zone. Habitat quality was limited because of the minimal riparian zone width and vegetative cover and the limited channel flow status. The total habitat assessment score was 149.

<u>Biology</u>
As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Clesson Brook at Station VP10CLE (described above) on 5 September 1996. DWM also conducted fish population sampling on 26 September 1996 in Clesson Brook. Fish collected in order of abundance included: blacknose dace (*Rhinichthys atratulus*), longnose dace *(Rhinichthys cataractae),* white sucker (*Catostomus commersoni*), slimy sculpin (*Cottus cognatus*), and creek chub (*Semotilus atromaculatus*). One of the species collected is considered intolerant of pollution. All fish species collected in this brook are fluvial specialists/dependants. The absence of macrohabitat generalists and the presence of slimy sculpin (intolerant) are indicative of generally good habitat and water quality conditions and stable flow regimes.

<u>Chemistry - Water</u>
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of Clesson Brook downstream from Hog Hollow Road off the east side of Route 112 in Buckland (Station VP10CLE) were made on 26 September 1996 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). DWM also collected water quality samples from Clesson Brook at Route 112 bridge northeast of Depot Road in Buckland (Station CL) between September 1995 and June 1996 (n = 9) and two upstream locations (Stations CL02 and SH01) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were collected from Clesson Brook at three stations on as many as six occasions between August and November 2000 by ESS (ESS 2002):

- Station DW21 at the confluence of Sheperd Brook and Clesson Brook, Buckland Four Corners;
- Station DW20 adjacent to the intersection of Route 112 and Charlemont Road, upstream of agricultural areas, midway to Smith Brook, Buckland; and
- Station DW19 near the confluence with the Deerfield River, Buckland.

DO and % saturation
Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.5 mg/L or 90.6% saturation. Saturation was as high as 105.2%.

Temperature
The maximum instream temperature was 17.1°C.

pH
The pH ranged from 7.0 to 7.3 SU at all three locations.

Turbidity
Turbidity ranged from 0.08 to 1.92 NTU.

Conductivity
Specific conductivity measurements ranged from 13.2 to 132.6 µS/cm.

The *Aquatic Life Use* for Clesson Brook is assessed as support based on the limited water quality data and best professional judgment. It is noteworthy that although temperature and oxygen levels met cold water fishery standards, salmonids were not collected during sampling of this proposed cold water fishery. This use is, therefore, identified with an “Alert Status” because of the absence of salmonids in the fish population sample and because the habitat assessment identified a number of potential concerns that may be impacting the habitat.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Clesson Brook at Route 112 bridge northeast of Depot Road in Buckland (Station CL) between September 1995 and June 1996 (n = 8) and several upstream locations (Stations SH01, CL02, CL03, and UB01) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

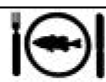
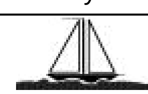
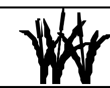
Fecal coliform bacteria samples were collected from Clesson Brook at three stations on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS (ESS 2002). Four of the sampling events were conducted during the *Primary Contact Recreational* season of April 15 through October 15. Results were:

- Station DW21 at the confluence of Sheperd Brook and Clesson Brook, Buckland Four Corners - fecal coliform bacteria counts ranged from 6 to 70 col/100 mL;
- DW20 adjacent to the intersection of Route 112 and Charlemont Road, upstream of agricultural areas, midway to Smith Brook, Buckland - fecal coliform bacteria counts ranged from 6 to 100 col/100 mL; and
- DW19 near the confluence with the Deerfield River, Buckland - fecal coliform bacteria counts ranged from 8 to 60 col/100 mL.

With the exception of some decomposing algae and associated strong odors no other objectionable deposits, sheens or conditions were noted during the biological monitoring survey conducted by DWM biologists in Clesson Brook in September 1995 (Appendix C).

The *Recreational* and *Aesthetics* uses are assessed as support for Clesson Brook based on the low fecal coliform bacteria counts and the habitat quality information.

Clesson Brook (MA33-15) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

* Alert Status issues identified, see details in use assessment section

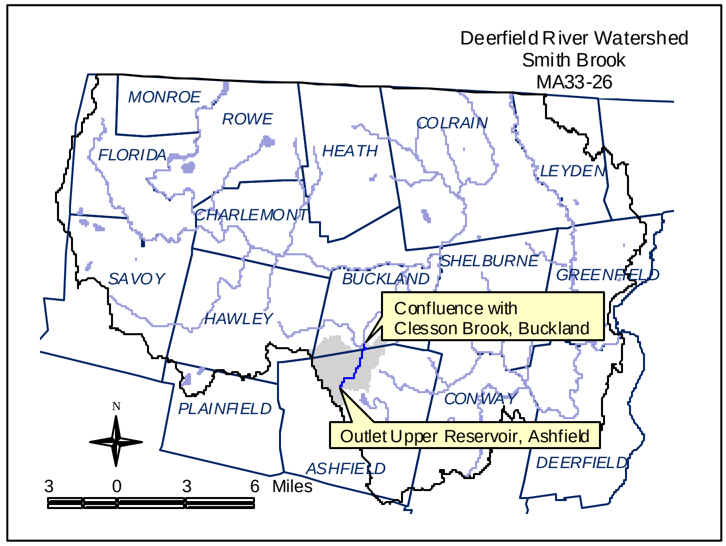
RECOMMENDATIONS CLESSON BROOK (MA33-15)

- Water quality monitoring in Clesson Brook should be conducted during the next monitoring year cycle (2005) to assess whether or not nutrient enrichment is occurring in this subwatershed from nonpoint sources of pollution, including agricultural inputs. In addition, fish population sampling should be conducted in Clesson Brook to document the presence of salmonids.
- Between the 1995 and 2000 year surveys on this stream NRCS worked with several landowners to implement agricultural BMPs in this subwatershed. These activities may have contributed to the drop in coliform bacteria measured in the stream below the agricultural areas. It is recommended that NRCS and DFA continue to work with landowners to maintain and expand the use of BMPS to protect riparian areas and prevent agricultural runoff and streambank erosion.
- Based on MA DFWELE recommendations, Clesson Brook and several tributaries in its subwatershed - Cooley, Ruddock, and Sheperd brooks - should be protected as cold water fishery habitat.
- The Towns of Ashfield, Buckland and Hawley should participate in the Deerfield River Watershed Regional Open Space Planning Projects, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Clesson Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Ashfield, Buckland and Hawley should support recommendations of their recently developed individual municipal open space plans and/or

Community Development Plans to protect important open space and maintain their communities' rural character.

- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Clesson Brook subwatershed identified and mapped extensive patches of this plant growing between Buckland Four Corners and Clesson Brook's confluence with the Deerfield River. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

SMITH BROOK (SEGMENT MA33-26)
Location: Headwaters, outlet Upper Reservoir, Ashfield, to confluence with Clesson Brook, Buckland.
Segment Length: 2.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 5.77 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.8%
Agriculture	7.5%
Open Land	6.8%

The headwaters of Smith Brook begin at Bear Swamp in Ashfield and then flow into Upper Reservoir. Smith Brook then flows north to its confluence with Upper Branch near the intersection of Apple Valley Road and Smith Road in Ashfield. The brook then flows along Route 112 to its confluence with Clesson brook in Buckland Four Corners (Buckland).

MA DFWELE has recommended that Smith Brook and its tributary Upper Branch be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Ashfield Landfill/Demolition /Wood Waste Landfill. The Ashfield Landfill/Demolition/Wood Waste Landfill is over 25 years old and is capped and lined. The site contains municipal waste and wood waste, is within one-half mile of private water supplies, 0.9 miles from of a community wellhead protection area, and approximately 2000 feet from Smith Brook. In 2002 MA DEP required the Town of Ashfield to prepare an Initial Site Assessment including test borings, monitoring wells, and soil and water sampling. Since this sampling is planned, Fuss and O'Neill did not recommend that screening level sampling be performed at this site under their study.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
Smith Brook was sampled by DWM biologists downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) in September 1996 as part of the MA DEP Biocriteria Development Project. At the time of the survey the brook was roughly 10 m wide with depths ranging from 0.25 m to 0.5 m. The substrates were comprised primarily of cobble, sand and boulders. The overall habitat score was 147 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, the riparian vegetative zone width and bank vegetative cover.

Biology
Smith Brook was sampled by DWM downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) in September 1996 as part of the DWM Biocriteria Development Project (Appendix C). Fish species captured in order of abundance included slimy sculpin (*Cottus cognatus*), rainbow trout (*Onchorynchus mykiss*), longnose dace (*Rhinichthys cataractae),* blacknose dace (*Rhinichthys atratulus*), and brook trout (*Salvelinus fontinalis*) (MA DEP 1996b). Multiple age classes of both rainbow and brook trout were present. All fish species collected in this brook are fluvial

specialists/dependants. The presence of multiple age classes of brook and rainbow trout, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

<u>Chemistry-water</u>
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Smith Brook were taken downstream from the confluence with Upper Branch in Ashfield (Station VP04SMI) on 24 September 1996 and near the confluence with Clesson Brook in Buckland (Four Corners) and Upper Branch (Station UB01) on 27 September 1995 (Appendix G, Table G3).

No recent data are available so the *Aquatic Life Use* is not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample each from Smith Brook near the confluence with Clesson Brook in Buckland (Four Corners) and from Upper Branch (Station UB01) on 27 September 1995 (Appendix G, Table G4).

With the exception of a sewage odor noted in the upper area of the stream reach sampled by DWM biologists in Smith Brook in September 1996, no other objectionable deposits, or conditions were noted (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses, so they are not assessed.

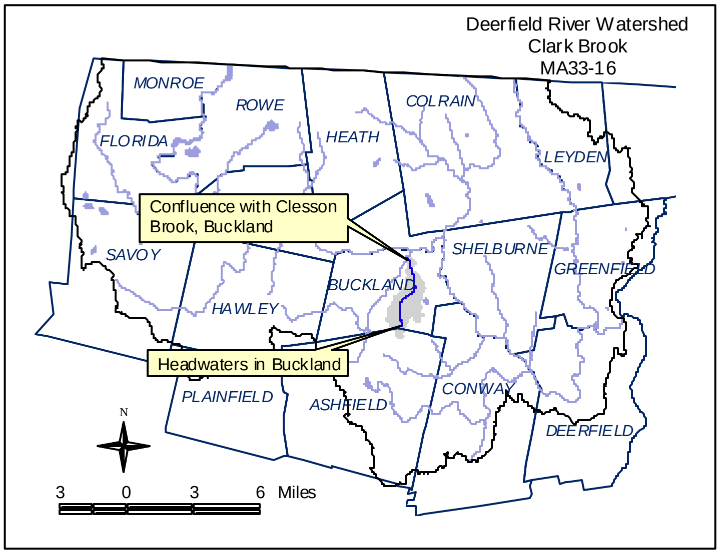
Smith Brook (MA33-26) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
NOT ASSESSED				

RECOMMENDATIONS SMITH BROOK (MA33-26).

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to assess the status of designated uses.
- Smith Brook and its tributary Upper Branch should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Town of Ashfield should participate in the Deerfield River Watershed Regional Open Space Planning Projects, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Smith Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Ashfield should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

CLARK BROOK (SEGMENT MA33-16)
Location: Headwaters, near Moonshine Road (Howes Road)/East Buckland Road, Buckland, to confluence with Clesson Brook, Buckland.
Segment Length: 3.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.88 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	88.0%
Agriculture	6.3%
Residential	3.2%

Clark Brook originates in Buckland and flows through a steep narrow valley between Mary Lyon Hill and Moonshine Hill. The brook parallels East Buckland Road until it flows under Route 112 and then joins Clesson Brook in a small, unnamed pond just before the confluence of Clesson Brook with the Deerfield River in Buckland.

MA DFWELE has recommended that Clark Brook be protected as a cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

<u>Habitat and Flow</u>
One stream reach in Clark Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located upstream from Route 112 in Buckland (Station VP09CLA) and was surveyed as part of the MA DEP biocriteria development project in September 1996, 1997 and 2000. In September 2000 the river was approximately 4 m wide with depths ranging from 0.1 to 0.3m in riffle habitat (Appendix B, MA DEP 1996b, and MA DEP 1997). The total habitat assessment score was 179.

<u>Biology</u>
As part of the MA DEP biocriteria development project, benthic macroinvertebrate samples were collected by DWM biologists from Clark Brook upstream of Route 112 in Buckland (Station VP09CLA) on 5 September 1996, 24 September 1997 and again on 25 September 2000 (Appendices B, MA DEP 1996b, and MA DEP 1997). The fish population in Clark Brook (Station VP09CLA) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*), rainbow trout (*Onchorynchus mykiss*) and an individual creek chub (*Semotilus atromaculatus*) in 1996 and multiple age classes of brook trout, rainbow trout (multiple age classes) and blacknose dace (*Rhinichthys atratulus*) in 1997 (MA DEP 1996b and MA DEP 1997). MA DFWELE also conducted fish population sampling in Clark Brook using backpack shocking on 9 August 2000 near the most downstream East Buckland Road bridge crossing. Brook trout (multiple age classes), blacknose dace, white sucker (*Catostomus commersoni*) creek chub (*Semotilus atromaculatus*), rainbow trout, and one each of longnose dace (*Rhinichthys cataractae*) and slimy sculpin (*Cottus cognatus*) were captured. Four of the species collected are considered intolerant of pollution. All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook and rainbow trout, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

<u>Chemistry-water</u>
DWM collected water quality samples from Clark Brook at the Route 112 Bridge (Station CK) in November and December 1995 and April, May and June 1996 (n = 6) as part of the 1995/1996 Deerfield River monitoring survey (Appendix G, Tables G3 and G4). DWM also sampled one station on Clark Brook in Buckland (Station VP09CLA) on 26 September 1996 and 8 October 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included DO, %saturation, pH, temperature, conductivity, and turbidity.

The *Aquatic Life Use* in Clark Brook is assessed as support based primarily on the fish population information. The presence of multiple age classes of brook and rainbow trout is indicative of excellent habitat and water quality. Furthermore, these fish are fluvial specialists, which suggests that the flow regime has not been compromised in this brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples from Clark Brook at Route 112 bridge in Buckland (Station CK) between November 1995 and June 1996 (n = 6) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

No objectionable deposits, odors or conditions were noted during the biological monitoring surveys conducted by DWM biologists in Clark Book in September 1996, 1997 and 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997).

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

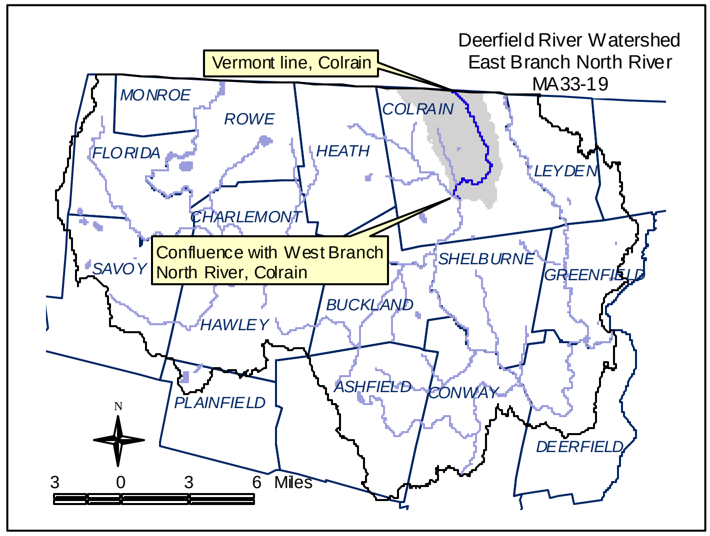
Clark Brook (MA33-16) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS CLARK BROOK (MA33-16)

- Conduct water quality and biological monitoring in Clark Brook during the next monitoring year cycle (2005) to more completely assess the status of designated uses.
- Clark Brook should be protected a cold water fishery habitat as recommended by MA DFWELE.
- The Town of Buckland should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these projects the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Clark Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Buckland should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

EAST BRANCH NORTH RIVER (SEGMENT MA33-19)
Location: Vermont/Colrain line, to confluence with West Branch North River, Colrain.
Segment Length: 7.6 miles
Classification: Class B, Cold Water Fishery



The Massachusetts portion of the drainage area of this segment is approximately 13.82 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.5%
Agriculture	11.4%
Residential	3.1%

The East Branch of the North River is formed by the confluence of three streams in the Town of Jacksonville, VT. The East Branch parallels Route 112 and enters Massachusetts in the Town of Colrain. The stream continues to follow Route 112 and joins the West Branch of the North River in the Village of Lyonsville. The segment ends at this point and the river becomes the North River proper. Most of the agricultural activities in this subwatershed are in close proximity to the river.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills
The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified one historic landfill in this segment; the Colrain Brush Landfill/Former Town Dump. This landfill is over 25 years old. The former town dump portion received demolition waste, industrial waste and municipal solid waste. This portion, closed in 1976, is not capped or lined. The brush dump was closed and capped in 1989. The site is within 50 feet of the North River and within one half mile of public and private water supplies and potentially productive aquifers. Fuss and O'Neill (2003) concluded that this site ranked high for the potential to impact sensitive environmental receptors and recommended it for screening level sampling. Samples collected in April 2003 from a groundwater seep on the bank of the North River downgradient of the landfill were high in iron (95,400 µg/L), manganese (8,250 µg/L), and cadmium (1.8 µg/L). No VOCs were detected.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
The East Branch North River has been experiencing major erosion in localized areas. The river is naturally subject to high and flashy spring flows and spring ice jams that contribute to streambank erosion. There is also a past history of gravel mining in and near the river that likely has impacted the geomorphology and hydrology of this segment. A Section 319 bioengineering project was implemented in an area that was eroding and threatening town water supply wells in 1993 (MA DEP 1996c). The project failed several years after installation, but at the time of this report the water supply wells had not been damaged by further erosion in this area. Agricultural (i.e., small-scale farming) activities are common along the North River and its East Branch - in many cases crops are planted immediately adjacent (i.e., minimally buffered) to the river.

The East Branch North River was sampled by DWM downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. At the time of the survey the river was roughly 13 m wide with depths ranging from 0.3 m to 0.9 m. The substrates were comprised primarily of boulders and cobble. The overall habitat score was 190 (Appendix B). The stream banks, although steep, were stable.

Biology

Compared to the Cold River reference station (Station CR01), the RBP III analysis indicated the benthic community was non/slightly impacted in the East Branch North River downstream from the Route 112 bridge, Colrain (Station NOR02A) in September 2000. The presence of a certain macroinvertebrate species indicative of high concentrations of suspended organics provided evidence of nutrient enrichment of this stream (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the East Branch North River in 1988 (Appendix C). Although fish sampling efficiency was rated as poor due to stream width and depth encountered, fish species captured by DWM in September 2000, in order of abundance, included Atlantic salmon (*Salmo salar*), longnose dace *(Rhinichthys cataractae)*, blacknose dace (*Rhinichthys atratulus*), and one each of yellow bullhead (*Ameiurus natalis),* banded killifish (*Fundulus diaphanous*), and tessellated darter (*Etheostoma olmstedi*) (Appendix B). Only the Atlantic salmon is considered to be intolerant of pollution.

DWM biologists collected periphyton samples from station NORO2A (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as <1% and percent algal cover was 100%. This site had a thin covering of coccoid green algae on 100% of the stable substrates, which is an indication of slightly enriched conditions but not considered nuisance algae growth (Appendix D).

Chemistry

DWM collected water quality samples from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 (Appendix G, Tables G3 and G4).

Water quality samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6) on as many as six occasions between August and November 2000 by ESS as part of a study performed for the Deerfield Watershed Team (ESS 2002).

DO and % saturation

Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.2 mg/L or 93.9% saturation. Saturation was as high as 106.6%.

Temperature

The maximum instream temperature was 19.6°C.

pH

The pH ranged from 6.9 to 7.4 SU.

Turbidity

Turbidity ranged from 0.60 to 41.8 NTU although five of six measurements were less than 1.6 NTU. The elevated turbidity occurred during a wet weather event in October 2000.

Conductivity

Specific conductivity measurements ranged from 80.3 to 107.8 µS/cm.

The *Aquatic Life Use* is assessed as support for the East Branch North River based primarily on the benthic macroinvertebrate community analysis and the limited water quality data. It should be noted, however, that nutrient/organic loadings originating from various forms of runoff (especially upstream agriculture, road crossings, and NPS inputs originating from Colrain center) probably contribute to the slightly enriched nature of this stream system (Appendix B) so the *Aquatic Life Use* is identified with an Alert Status. Streambank erosion in localized areas along this segment is also of concern.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

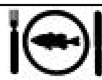
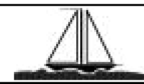
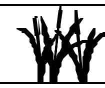
DWM collected one fecal coliform bacteria sample from the East Branch North River approximately 700 feet upstream from the Route 112 bridge in Colrain (Station EBNR06) in August 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the East Branch North River below Lyonsville Village, north of the Arthur-Smith Covered Bridge, Colrain (Station DW6), on six occasions between August and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts during the *Primary Contact Recreational* season (n=4) ranged from 50 to 280 cfu/100 mL, with only one of the four samples exceeding 200 cfu/100 mL. The elevated bacteria count was during a wet weather event in September.

No objectionable deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the East Branch North River in September 2000 (Appendix B).

The *Recreational* and *Aesthetics Uses* are assessed as support for East Branch North River based on the generally low fecal coliform bacteria counts and the habitat quality information. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of the slightly elevated bacteria count documented by ESS during one wet weather event.

East Branch North River (MA33-19) Use Summary Table

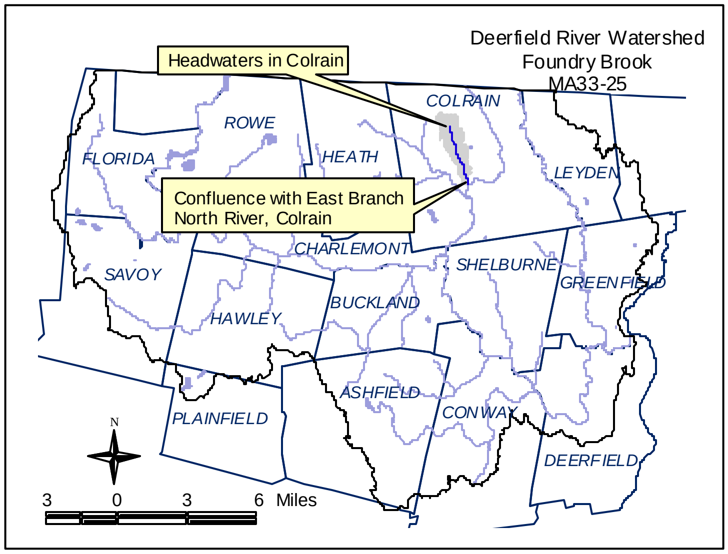
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT*	SUPPORT	SUPPORT

*Alert Status issues identified, see details in the use assessment section

RECOMMENDATIONS EAST BRANCH NORTH RIVER (MA33-19)

- Continue to conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005). In particular, biomonitoring is recommended here and fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring throughout the East Branch subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.
- Support local efforts to control streambank erosion. The NRCS and the Colrain Elementary School are currently collaborating on a streambank stabilization project on an eroding section of riverbank adjacent to the school.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the East Branch of the North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study for management of the Colrain Brush Landfill/Former Town Dump including: performing additional field investigation to assess environmental risk, identifying and characterizing the extent of any impacts that may be present, and determining the need for corrective action. The report identified significant quantities of exposed refuse within 50 feet of the North River and groundwater seeps hydraulically connected to the North River as major issues of concern.

FOUNDRY BROOK (SEGMENT MA33-25)
Location: Headwaters, north of Calvin Coombs Road, Colrain, to confluence with East Branch North River, Colrain.
Segment Length: 2.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.18 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.8%
Agriculture	13.6%
Residential	2.2%

Foundry Brook originates on the southeastern slope of Christian Hill in Colrain. The brook then flows south, through a narrow valley, to Foundry Village. The brook then joins the East Branch of the North River in Foundry Village in the Town of Colrain.

MA DFWELE has recommended that Foundry Brook be protected as a cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
One stream reach in Foundry Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located approximately 1000 m upstream from its confluence with the East Branch North River in Colrain (Station VP07FOU) and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000 (Appendix B, MA DEP 1996b and MA DEP 1997). In September 2000 the river was approximately 3 m wide with depths ranging from 0.1 to 0.3 m in the riffle habitat. The total habitat assessment score was 158. Habitat was most limited by sediment deposition and lack of instream habitat diversity (i.e., limited velocity/depth combinations).

Biology
As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Foundry Brook approximately 1000 m upstream from its confluence with the East Branch North River in Colrain (Station VP07FOU) on 5 September 1996, 25 September 1997 and again on 26 September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997). No RBP III analysis is available from these samples. The fish population in Foundry Brook (Station VP09CLA) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) and slimy sculpin (*Cottus cognatus*) in 1996 and 1997 (MA DEP 1996b and MA DEP 1997). Both fish species are considered intolerant of pollution and are indicative of excellent habitat and water quality conditions.

Chemistry-water
DWM sampled one station on Foundry Brook in Colrain (Station VP07FOU) on 25 September 1996 and 8 October 1997 as part of the Biocriteria Development Project (MA DEP 1996b and MA DEP 1997). *In-situ* measurements included: DO, %saturation, pH, temperature, conductivity, and turbidity.

Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of additional water quality and biological data the *Aquatic Life Use* is not assessed for Foundry Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Foundry Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational Uses* the *Aesthetics Use* is assessed as support.

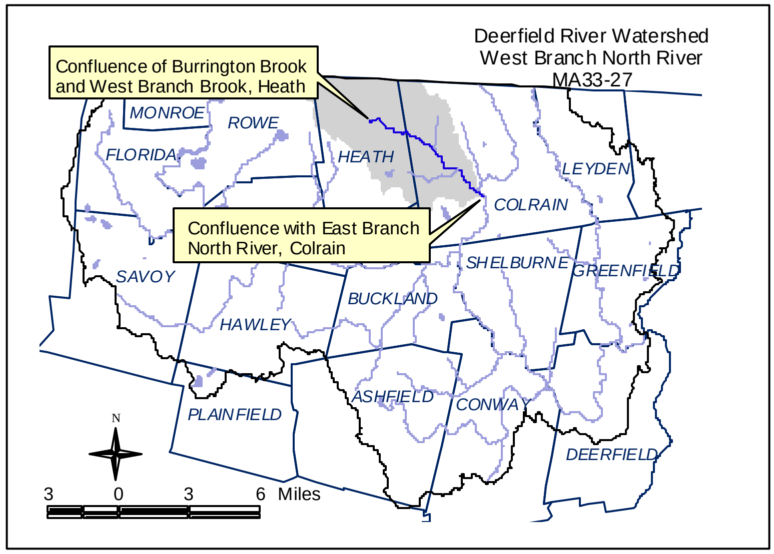
Foundry Brook (MA33-25) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS FOUNDRY BROOK (MA33-25)

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to more completely assess the status of designated uses.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- Based on MA DFWELE recommendations Foundry Brook should be protected as a cold water fishery habitat.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Foundry Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

WEST BRANCH NORTH RIVER (SEGMENT MA33-27)
Location: Confluence of Burrington Brook and West Branch Brook, Heath to confluence with East Branch North River, forming the North River, Colrain.
Segment Length: 7.1 miles
Classification: Class B, Cold Water Fishery



The Massachusetts portion of the drainage area of this segment is approximately 26.4 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	82.4%
Agriculture	9.4%
Open Land	4.4%

The West Branch of the North River is formed by the confluence of West Branch Brook and Burrington Brook on the border between the Towns of Heath and Colrain. The West Branch North River then parallels Adamsville Road as it flows southeast to its confluence with the East Branch North River, upstream from Griswoldville in the Town of Colrain.

MA DFWELE has recommended that West Branch and Underwood brooks, tributaries to the West Branch North River, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow
The West Branch North River has been experiencing major erosion in localized areas. The river is naturally subject to high and flashy spring flows and spring ice jams that contribute to streambank erosion.

Biology
MA DFWELE conducted fish population sampling in the West Branch North River between August 2000 and September 2001. At the most upstream station near the confluence with Sanders Brook, three species were collected in August 2000 including blacknose dace (*Rhinichthys atratulus*), slimy sculpin *(Cottus cognatus*), and longnose dace *(Rhinichthys cataractae)* (one intolerant species). Further downstream, above the confluence with Taylor Brook, fish collected in August 2000 in order of abundance included: slimy sculpin, blacknose dace, longnose dace, Atlantic salmon (*Salmo salar*) (multiple age classes), white sucker (*Catostomus commersoni*), brown trout (*Salmo trutta*), longnose sucker (*Catostomus catostomus*), eastern brook trout (*Salvelinus fontinalis*), and one brown bullhead (*Ameiurus nebulosus*). In September 2001 only three species (Atlantic salmon and brown and brook trout) were collected from the West Branch North River near to its confluence with Taylor Brook. Multiple age classes of Atlantic salmon and brook trout were documented (Richards 2003). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry

DWM collected water quality samples from the West Branch North River just upstream from the bridge across from Branch Cemetery on Adamsville Road, Colrain (Station WBNR05) in August 1995 (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* is assessed as support for the West Branch North River based on best professional judgment of the fish community information. The species collected in the river are indicative of excellent water quality and habitat conditions.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample from the West Branch North River just upstream from the bridge across from Branch Cemetery on Adamsville Road, Colrain (Station WBNR05) in August 1995 (Appendix G, Table G4).

No current data are available so the *Recreational* and *Aesthetics* uses are not assessed for the West Branch North River.

West Branch North River (MA33-27) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

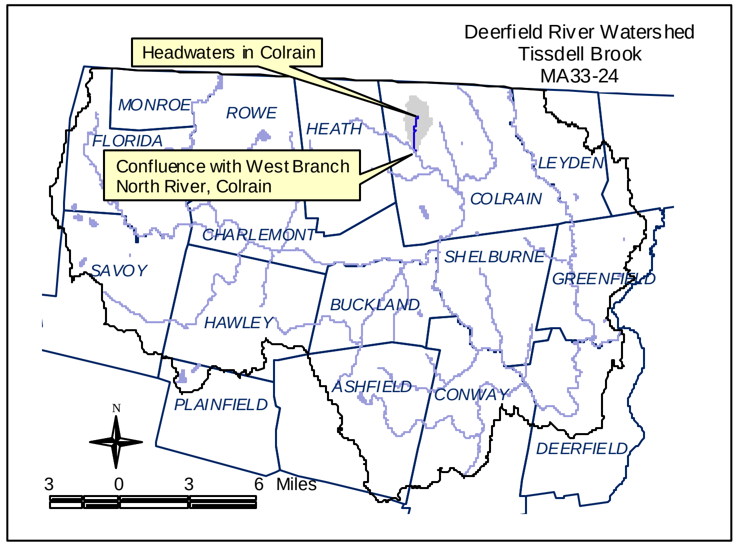
RECOMMENDATIONS WEST BRANCH NORTH RIVER (MA33-27)

- Conduct water quality and biological monitoring in this segment during the next monitoring year cycle (2005) to more completely assess the status of designated uses. In particular, sampling should include biological monitoring as well as physicochemical, nutrient, and bacteria sampling to address impacts of potential nonpoint sources of pollution and riverbank erosion.
- West Branch and Underwood brooks, tributaries to the West Branch North River should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Towns of Colrain and Heath should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these Towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the West Branch North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Colrain and Heath should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

TISSDELL BROOK (SEGMENT MA33-24)
Location: Headwaters, west of Christian Hill, Colrain, to confluence with West Branch North River, Colrain.
Segment Length: 1.7 miles.
Classification: Class B.

The drainage area of this segment is approximately 1.73 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	79.7%
Agriculture	13.8%
Residential	5.6%



Tissdell Brook originates on the southern slope of Christian Hill, Colrain. The brook then flows south to its confluence with the West Branch of the North River, approximately 0.75 miles upstream from the Village of Adamsville in the Town of Colrain.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow
One stream reach in Tissdell Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located approximately 700 m upstream from Adamsville Road in Colrain (Station VP08TIS) and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000. In September 2000 the river was approximately 5 m wide with depths of approximately 0.1 m in the riffle habitat (Appendix B, MA DEP 1996b, and MA DEP 1997). The total habitat assessment score was 164. Habitat was most limited by sediment deposition, channel flow status and lack of instream habitat diversity (i.e., limited velocity/depth combinations).

Biology
As part of the MA DEP Biocriteria Development Project, benthic macroinvertebrate samples were collected by DWM biologists from Tissdell Brook approximately 700 m upstream from Adamsville Road in Colrain Station VP08TIS) on 5 September 1996, 25 September 1997 and 26 September 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997). No RBP III analysis was available from these samples. The fish population in Tissdell Brook (Station VP08TIS) was comprised of multiple age classes of brook trout (*Salvelinus fontinalis*) and slimy sculpin (*Cottus cognatus*) in 1996 and 1997 (MA DEP 1996b and MA DEP 1997). Both fish species are considered intolerant of pollution and are fluvial specialists/dependants, which is indicative of excellent habitat and water quality conditions as well as stable flow regimes.

Chemistry-water
DWM sampled one station on Tissdell Brook approximately 700 m upstream from Adamsville Road in Colrain (Station VP08TIS) on 25 September 1996 and 8 October 1997 as part of the Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included; DO, %saturation, pH, temperature, conductivity, and turbidity.

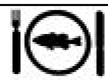
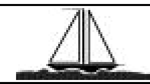
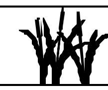
Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of sufficient water quality and biological data the *Aquatic Life Use* is not assessed for Tissdell Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Tissdell Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b, and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational* uses the *Aesthetics Use* is assessed as support.

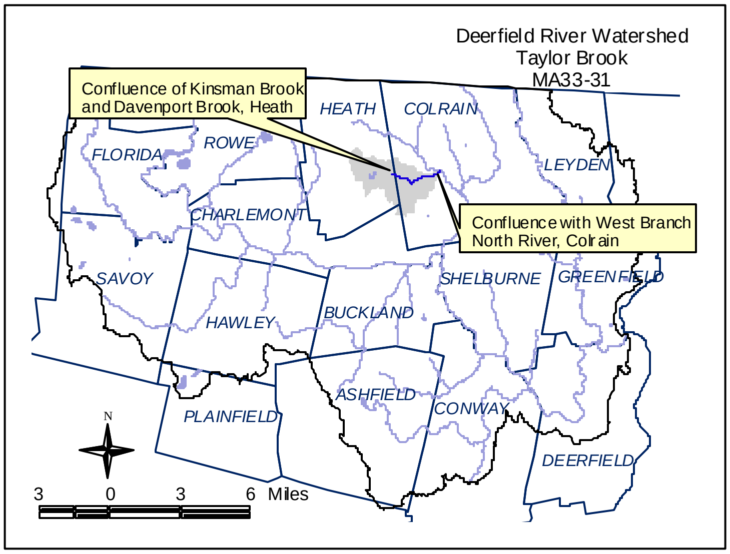
Tissdell Brook (MA33-24) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS TISSDELL BROOK (MA33-24)

- Conduct water quality and biological monitoring in Tissdell Brook during the next monitoring year cycle (2005) to assess the status of designated uses.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the Town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Tissdell Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

TAYLOR BROOK (SEGMENT MA33-31)
Location: From confluence of Kinsman Brook and Davenport Brook, Heath to the confluence with West Branch North River, Colrain.
Segment Length: 2.6 miles.
Classification: Class B.



The drainage area of this segment is approximately 5.18 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	77.0%
Open land	10.6%
Agriculture	8.0%

Taylor Brook begins at the confluence of Kinsman and Davenport Brooks in the Town of Heath. The brook then flows east to its confluence with the West Branch North River in the Town of Colrain, approximately 0.5 miles downstream from Adamsville.

MA DFWELE has recommended that Taylor Brook and its tributary Kinsman Brook, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
One stream reach in Taylor Brook was sampled by DWM biologists in September 2000 (Appendix B). The reach was located upstream from Heath Road in Colrain (Station TB00). At the time of the survey the brook was roughly 8 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 157 (Appendix B). Habitat quality was limited most by sediment deposition and the channel flow status. Both banks were well vegetated and the forested riparian zone provided ample stream shading. Instream sedimentation, presumably originating from streambank instability (i.e., erosion) and/or road runoff, was identified as being of concern in this subwatershed by DWM biologists (Appendix B).

Biology
Compared to the Bear River reference station (Station VP11BEA) the RBP III analysis indicated the benthic community was non-impacted in Taylor Brook upstream from Heath Road in Colrain (Station TB00) in September 2000 (Appendix B). Fish species present included slimy sculpin (*Cottus cognatus*), Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis),* white sucker (*Catostomus commersoni)*, longnose sucker (*Catostomus catostomus*), blacknose dace (*Rhinichthys atratulus*), and longnose dace *(Rhinichthys cataractae)* (Appendix B). Five of the species collected are considered to be intolerant of pollution and are all fluvial specialists/dependants. All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes.

DWM biologists collected periphyton samples from Station TB00 (described above) at the same time as the September 2000 macroinvertebrate/habitat assessment at this station was conducted.

Canopy cover was reported as 100% and percent algal cover was <5%. The dominant algal type and form was greens/thin film. No nuisance algal growth was documented (Appendix D).

> Note: Water quality samples were collected from Davenport Brook (Station DW5), a tributary at the headwaters of Taylor Brook on as many as six occasions between August and November 2000 by ESS (ESS 2002). Although the data were not used to assess Taylor Brook, results are summarized below.
>
> *DO and % saturation*
> Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 10.85 mg/L or 93.2% saturation. Saturation was as high as 99.4%.
>
> *Temperature*
> The maximum instream temperature was 16.2°C.
>
> *pH*
> The pH ranged from 6.7 to 7.1 SU.
>
> *Turbidity*
> Turbidity ranged from 0.29 to 1.57 NTU.
>
> *Conductivity*
> Specific conductivity measurements ranged from 18.5 to 66.9 µS/cm.

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis and the fish population information. The *Aquatic Life Use* for Taylor Brook, however, is identified with an Alert Status because of the instream sedimentation concerns identified by DWM biologists.

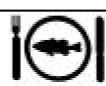
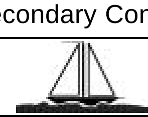
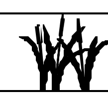
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

With the exception of some slight turbidity no other objectionable deposits, sheens or conditions were noted during the biological monitoring survey conducted by DWM biologists in Taylor Brook in September 2000 (Appendix B).

> Note: Fecal coliform bacteria samples were collected from Davenport Brook (Station DW5), a tributary at the headwaters of Taylor Brook on six occasions between August and November 2000 by ESS (ESS 2002). This sampling station was selected to evaluate any potential instream impacts due to septic system leachate from Heath Estates. Although the data were not used to assess Taylor Brook, fecal coliform bacteria ranged from <10 to 64 cfu/100 mL.

Although no bacteria data are available to assess the *Recreational uses,* the *Aesthetics Use* is assessed as support for Taylor Brook based on the habitat quality information.

Taylor Brook (MA33-31) Use Summary Table

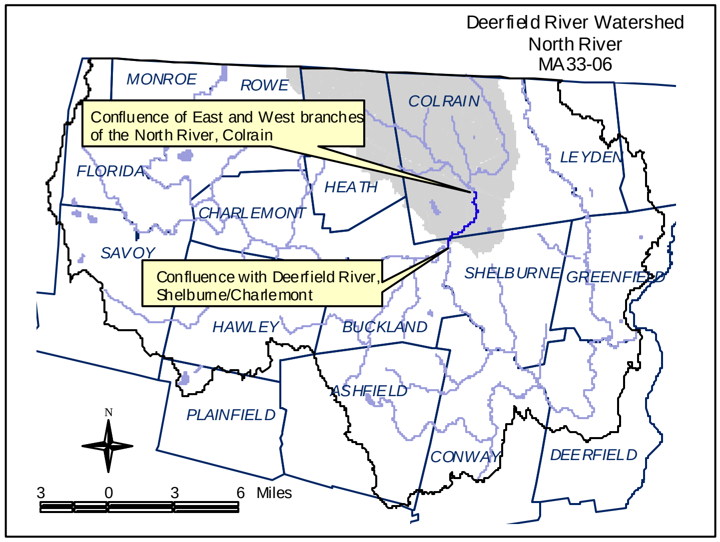
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS TAYLOR BROOK (MA33-31)

- While it is possible that the high-gradient nature of Taylor Brook allows for the “flushing through” of sediments before they can be a significant impediment to the integrity of resident biota, assessment of biological impairment related to increased sediment loads here, as well as impacts farther downstream in the West Branch North River, should be conducted during the next monitoring year (2005).
- Pursue 604b/319 or other sources of funding to evaluate and remediate areas of severe streambank erosion.
- Work with NRCS and DFA to encourage landowners to implement and maintain BMPs to protect riparian areas and control agricultural runoff.
- Taylor Brook and its tributary Kinsman Brook should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Towns of Colrain and Heath should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these Towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Taylor Brook subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Colrain and Heath should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities’ rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

NORTH RIVER (SEGMENT MA33-06)
Location: Confluence of East and West branches of the North River, Colrain to confluence with Deerfield River, Shelburne/Charlemont.
Segment Length: 3.3 miles
Classification: Class B, Cold Water Fishery



The drainage area of this segment is approximately 48.47 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	83.0%
Agriculture	9.4%
Open Land	3.3%

This segment is on the 1998 303(d) List of Waters for pathogens and taste, odor, and color (Table 2).

The North River is formed by the confluence of the East and West Branches of the North River in Colrain. This reach has been subject to severe erosion due primarily to spring ice jams. The river flows south and somewhat west, paralleling Route 112. A dam impounds the river a short distance below the confluence of the two branches. Below this the river enters the Village of Griswoldville where it receives treated waste, both domestic and industrial, from the BBA Nonwovens Simpsonville Incorporated Wastewater Treatment Facility. The floodplain narrows as the river flows toward its confluence with the Deerfield River. The North River flows by Shattuckville and enters the Deerfield River about a mile downstream, just south of River Road at the Buckland, Charlemont, and Shelburne town lines.

MA DFWELE has recommended that Houghton Brook (also referred to as Albee River), a tributary to the North River, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
BBA Nonwovens	N/A	N/A	10306601	North River	0.89	0.37	0.40	0.26	0.22
Shelburne Falls Fire District	1268000	P10326801	10326801	Fox Brook Reservoir-01S Well #1 Replacement-03G Well #2-02G	0.21	0.18	0.18	0.18	0.18

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)
BBA Nonwovens Simpsonville, Inc. is authorized (MA0003697 March 2001) to discharge, via outfall # 001, 1.35 MGD of treated industrial and domestic wastewater to the North River. The ammonia-nitrogen concentration shall not exceed 63 lbs/day. The LC_{50} shall be 100% of the effluent. The C-NOEC shall be determined on a sliding scale depending on the quantity of discharge. The C-NOEC shall equal 9% at a discharge of less than or equal to 0.5 MGD. The C-NOEC shall equal 21% at a discharge of less than or equal to 1.35 MGD. The recently issued permit required that BBA Nonwovens, Inc. conduct a "Color evaluation study of wastewater discharge into the North River". The study was found by DWM to adequately address the color issue and that no further color treatment was required (Hogan 2003).

BBA Nonwovens Simpsonville, Inc. is also permitted (MAR05B746) to discharge stormwater to the North River. As part of this permit BBA Nonwovens Simpsonville, Inc. is required to develop a SWPPP (Stormwater Pollution Prevention Plan).

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified three historic landfills in this segment; Kendall Mills Sludge Storage Site, Colrain Landfill, and the Slowinski Brush Dump. The Kendall Mills site is over 25 years old and received sludge for several years from the Kendall Mills Textile Plant treatment system. The site is unlined and not capped. The site was recommended for screening level sampling by Fuss and O'Neill (2003) due to its potential to impact sensitive environmental receptors. Sampling of a downgradient spring revealed low levels (below drinking water and surface water criteria) of barium, copper, manganese, and iron in the water. No further action was recommended for this site. The Colrain Landfill received municipal and industrial wastes and has been closed and capped since the late 1990s. Environmental monitoring has been conducted at the site since 1987, including a Comprehensive Site Assessment and post-closure monitoring. Because of extensive monitoring this site was not recommended for screening level sampling as part of the landfill study. The Slowinski Brush Dump received soil and stumps from a road construction project in the mid 1980s. In 1987 test pits were excavated to determine depth to groundwater and presence of an oxide layer. None were observed. The site is closed and was not recommended for screening level sampling by Fuss and O'Neill as part of their study.

Spills

An acid spill into the North River occurred at the BBA Nonwovens facility in September 1999. An extensive fish kill in the North River resulted from the spill of approximately 700 gallons of 93% sulfuric acid (Keller 1999). The reach affected was approximately 3 miles (to the confluence with the Deerfield River). Sodium bicarbonate (12 – 14 tons) was dumped into the river to help neutralize the acid. A Natural Resource Damage settlement was reached in 2003 for damages incurred.

USE ASSESSMENT

AQUATIC LIFE

<u>Habitat and Flow</u>

The North River is impounded at the BBA Nonwovens, Inc. dam located just downstream from the confluence of the East and West Branches of the North River. Downstream fish passage is available at this dam. A canal at the dam runs along the eastern side of Route 112 and bypasses approximately 0.6 miles of the North River. The facility currently withdraws water from this canal for use in their plant. According to USGS (remarks noted from their gaging station on the North River near Shattuckville, Colrain - 01169000) diurnal fluctuations at times are caused by the mill upstream but, because storage capacity is small, daily flows are not affected appreciably. Data from the USGS gage revealed that the 2000 annual mean flow (244 cfs) was greater than the mean annual flow for the period of record (63 years) of 187 cfs (Socolow *et. al*. 2001). The estimated 7Q10 flow at the gage is 8.1 cfs (USGS 2003).

The North River was sampled by DWM upstream from the Route 112 bridge (below the Village of Shattuckville) in Colrain (Station NOR01) in September 2000. At the time of the survey the brook was roughly 16 m wide with depths ranging from 0.3 m to 1.0 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 187 (Appendix B). The stream banks of this open canopied reach were stable and well vegetated.

<u>Biology</u>

Compared to the Cold River reference station (CR01) the RBP III analysis indicated the benthic community was non-impacted from the North River upstream from the Route 112 bridge (below the Village of Shattuckville) in Colrain (Station NOR01) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the North River in 1988 and 1995 (Appendix C). In September 2001, MA DFWELE conducted fish population sampling in the North River between North River and Frankton roads, Shelburne. The fish community was dominated by multiple age classes of Atlantic salmon (*Salmo salar*). One each of rainbow (*Onchorynchus mykiss*), brown (*Salmo trutta*) and brook trout (*Salvelinus fontinalis)* were also collected (Richards 2003). Although all four species present are considered intolerant of pollution, the dominance by Atlantic salmon and relative scarcity of the other salmonids is notable. Sampling efficiency was not specifically documented.

DWM biologists collected periphyton samples from Station NOR01 (described above) at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as <1% and percent algal cover was 90%. The dominant algal type and form was blue-greens/thin film. No nuisance algal growth (green filamentous) was documented (Appendix D).

Toxicity

Ambient

Water from this segment was collected approximately 125 feet upstream of the BBA Nonwovens Simpsonville, Inc. treated industrial and domestic wastewater discharge (Outfall #001) in Griswoldville for use as dilution water in the company's whole effluent toxicity tests. Between February 1997 and September 2002 survival of *C. dubia* and *P. promelas* exposed (7-day) to the river water ranged from 90 to 100% in the 21 tests conducted.

Effluent

A total of 21 definitive whole effluent toxicity tests were conducted on the BBA Nonwovens Simpsonville, Inc. effluent (Outfall #001) between February 1997 and September 2002 using *C. dubia* and *P. promelas*. The LC_{50} ranged from 50 to >100% for *C. dubia*. Eight of 21(38%) tests did not meet the permit requirements of LC_{50} = 100%. The whole effluent was not acutely toxic to *P. promelas*. The effluent was chronically toxic to C. dubia with CNOECs ranging from <6.25 to 50% effluent while the CNOEC results for *P. promelas* ranged between 50 and 100% effluent. *C. dubia* was consistently the most sensitive of the two species.

Chemistry-water

Water quality sampling was conducted by DWM in the North River at two locations; one site was located upstream from the BBA Nonwovens outfall at the Adamsville Road bridge in Colrain (Station NR04) and the other was downstream from the discharge near the Route 112 bridge in Griswoldville (Station NR03). These sites were sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). These two locations were also sampled by DWM in August 1995 (Appendix G, Tables G3 and G4). One additional location in the North River was sampled by DWM approximately 0.3 miles downstream from the USGS gaging station at Shattuckville in Colrain (Station NO) between June 1995 and June 1996 (n = 13 sampling events) (Appendix G, Tables G3 and G4).

Water quality samples were also collected from the North River at the two stations bracketing the BBA Nonwovens discharge (Stations NR04 and NR03, referred to by ESS as DW4 and DW3, respectively) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring in this segment of the North River at two locations: upstream fro BBA Nonwovens in Colrain (NOR-010) and downstream from BBA Nonwovens in Colrain (NOR-015). Samples were collected for pH, DO, alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

Water from the North River upstream from the BBA Nonwovens discharge was collected for use as dilution water in the BBA Nonwovens Simpsonville, Inc. whole effluent toxicity tests on 21 occasions between February 1997 and September 2002. Data from these reports (maintained in the TOXTD database) are summarized below.

DO and % saturation

DO levels in the North River measured by DWM and ESS in 2000 were not less than 9.3 mg/L and were as high as 13 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation ranged from 89.3 to a high of 110%, although supersaturation occurred only once. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature

The maximum temperature in the North River measured by DWM and ESS in 2000 was 19°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the North River upstream from the BBA Nonwovens discharge ranged between 6.5 and 7.8 SU and downstream from the discharge ranged from 6.9 to 7.4 SU (Appendix A, Tables A8 and A9, ESS 2002, and TOXTD database). No effects from the discharge on instream pH were documented. Alkalinity of the North River ranged from 12 to 54 mg/l (Appendix A, Table A9).

Suspended Solids
The highest reported suspended solids concentration in the North River was 18 mg/L (TOXTD). The maximum suspended solids concentration during the 2000 surveys was 5.4 mg/L (Appendix A, Table A9).

Ammonia-Nitrogen
The highest reported ammonia-nitrogen concentration was 0.21 mg/L (TOXTD). None of the measurements exceeded the Water Quality Criteria (WQC).

Total Residual Chlorine
With the exception of one measurement (0.12 mg/L) all of the 20 other TRC measurements were below the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements of the North River ranged from 12 to 52 mg/L (Appendix A, Table A9 and TOXTD database).

Phosphorus
Total phosphorus measurements in the North River upstream from the BBA Nonwovens discharge ranged from <0.01 to 0.017 mg/L (Appendix A, Table A9). Downstream from the discharge they ranged from 0.019 to 0.038 mg/L. All of the measurements taken were below 0.05 mg/L.

<u>Chemistry – sediment</u>
Sediment grab samples were collected at Station DWS-6 from behind the BBA Nonwovens dam on the North River in July of 2000 by ESS (ESS 2002). Sediments were analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic carbon), percent volatile solids, and percent water. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 12.6 ppm, which is approximately two times greater than the L-EL. Percent volatile solids, PAH, TPH, and PCB all were non-detectable.

The *Aquatic Life Use* for the North River is assessed as support based on the benthic macroinvertebrate community analysis, high survival of test organisms exposed to the river water, the water quality data, and the limited sediment quality data (with the exception of arsenic which was likely elevated due to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002)). Of concern, however, are the whole effluent toxicity (both acute and chronic) in the BBA Nonwovens, Inc. discharge (near field affects from this discharge were not evaluated) and the potential impact on flow in the 0.6-mile reach of the river that is bypassed via a canal. Because of these issues, the *Aquatic Life Use* is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION **AND** ***AESTHETICS***

DWM collected fecal coliform bacteria samples from the North River approximately 0.3 m downstream from the USGS gaging station in Shattuckville in Colrain (Station NO) between June 1995 and June 1996 (n =13) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the North River at two stations on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS. Four of the sampling dates fell within the *Primary Contact Recreational Season*.

- Station DW4 located at the bridge just north of Griswoldville on Adamsville Road; fecal coliform bacteria counts ranged from 50 to 180 col/100 mL during all sampling dates.
- Station DW3 located on the North River below BBA Nonwovens, Colrain; fecal coliform bacteria counts ranged from 22 to 240 col/100 mL. The single elevated bacteria count was during a wet weather event in September.

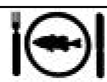
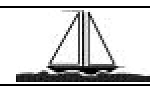
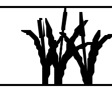
Fecal coliform bacteria sampling was also conducted by the DRWA in the North River at two locations between June and August 2001 and 2002 representing both wet and dry weather (DRWA 2001 and 2002).

- Station NOR-010 located upstream from BBA Nonwovens, Colrain; fecal coliform bacteria counts ranged from 42 to 773 in 2001 and 16 to 236 in 2002 (n = 6 wet and 4 dry weather sampling events).
- Station NOR-002 located just upstream from the confluence with the Deerfield River at Sunburn Beach in Colrain; fecal coliform bacteria counts ranges from 51 to 405 in 2001 and between 31 to 192 in 2002 (n = 7 wet and 4 dry weather sampling events).

No objectionable color (which was identified as a problem during the 1995/1996 Deerfield River surveys), deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the North River in September 2000 (Appendix B) or by field crews during any of the water quality surveys conducted in 2000.

The *Recreational* and *Aesthetics* uses are assessed as support for North River based on the generally low fecal coliform bacteria counts and the habitat quality information. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of the slightly elevated bacteria counts documented by ESS and DRWA during wet weather.

North River (MA33-06) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT*	SUPPORT	SUPPORT

*Alert Status issues identified, see details in the use assessment section

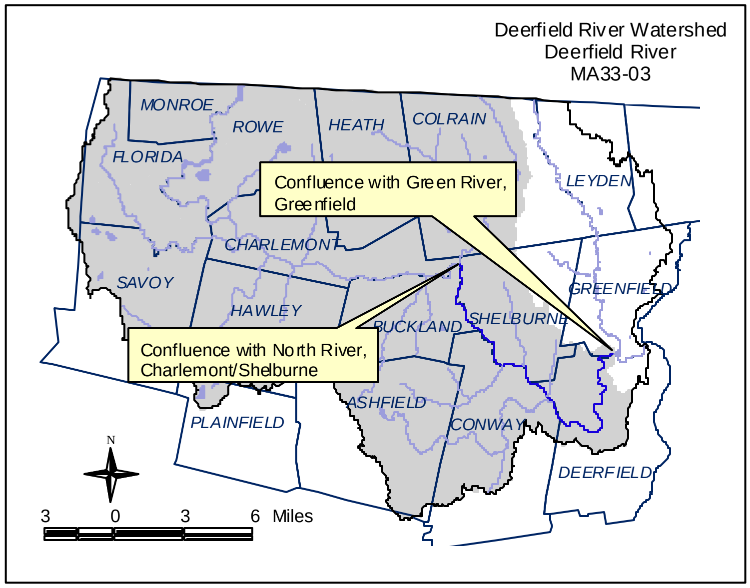
RECOMMENDATIONS NORTH RIVER (MA33-06)

- Water quality and biological monitoring should be conducted during the next assessment monitoring year (2005) to continue to assess designated uses. In particular, biomonitoring is recommended here and should include an upstream control station to continue to assess the potential impacts of the industrial discharge and various nonpoint source effects related to agriculture and urban runoff in this portion of the North River subwatershed. In addition to benthic macroinvertebrate biomonitoring, attempts should be made to conduct fish population sampling as well. Due to the wide and deep nature of the NOR01 sampling reach fish population sampling should utilize multiple crews or a barge-mounted electrofishing unit.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program.
- Evaluate the possibility of removing this segment from the 303(d) List for taste, odor and color (water quality monitoring observations do not indicate problem still exists from 1995).
- Houghton Brook (also referred to as Albee River), a tributary to the North River, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- A Natural Resource Damage settlement was reached in 2003 for damages incurred from the acid spill in 1999. Approximately $30,000 will be available for environmental improvements in the watershed. Work with appropriate groups to help determine most effective way(s) to direct this money for environmental protection.
- Work with dam owner (currently BBA Nonwovens) to explore options and funding sources for dam removal.

- The Town of Colrain should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the North River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Colrain should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

DEERFIELD RIVER (SEGMENT MA33-03)

Location: Confluence with North River, Charlemont/Shelburne, to confluence with Green River, Greenfield.
Segment Length: 17.0 miles.
Classification: Class B, Warm Water Fishery.



The drainage area of this segment is approximately 291.49 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	83.3%
Agriculture	8.0%
Residential	3.4%

From the confluence with the North River the Deerfield River heads due south through the Towns of Buckland and Shelburne. Then it resumes a southeasterly course passing over three hydroelectric dams in the next three miles. The river continues to form the boundary between Buckland and Shelburne and then Conway and Shelburne and finally Conway and Deerfield before entering Deerfield. In this stretch the river is joined by the Bear and South Rivers. In Deerfield the river enters a broad valley where the bedrock changes from metamorphic and igneous rock to sedimentary sandstone and shale. The velocity in this stretch slows due to low gradient and backwater from the Connecticut River. As the river passes under Route 91 it meanders north again through South and North Meadows, paralleling the highway. At the border between Deerfield and Greenfield the river turns east again and is joined by the Green River near the golf course in south Greenfield.

MA DFWELE has recommended that two tributaries to this segment of the Deerfield River, Sluice and Hawks brooks, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
					1998	1999	2000	2001
Deerfield Fire District	1074000	10307401	Harris Spring-04G Keats Spring-02G Stillwater Spring-06G Stillwater Well-05G Wells Spring-03G* GP Well Rt. 5/ Wapping Well-01G	0.1	0.12**	0.13**	0.15**	0.19**
Savage Farms Inc.		10307403	Savage Farm #1 Savage Farm #2 Savage Farm #3 Savage Farm #4	0.29	0.04	0.07	0.01	0.1
Williams Farm Inc.		10307402	Williams Farm #1 Williams Farm #2 Williams Farm #3 Williams Farm #4	0.08	Not reported	0.12**	0.01	0.12**

*This source (Wells Spring-03G) is located in the Connecticut River Basin (Segment MA34-04), **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H1, H2, AND H4)

USGenNE is authorized to discharge at the Deerfield No.4 Station via three outfalls to the Deerfield River in Buckland (NPDES permit MA0034860 issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of floor drain water,
- Outfall 002: 0.06 MGD transformer cooling water, and
- Outfall 003: 0.0216 MGD bearing cooling water.

USGenNE is authorized to discharge at the Deerfield No.3 Station via four outfalls to the Deerfield River in Buckland (NPDES MA0034851 permit issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of internal facility drainage,
- Outfall 002: 0.06 MGD transformer non-contact cooling water,
- Outfall 003: 0.0216 MGD bearing contact cooling water, and
- Outfall 004: 0.0432 MGD cooling water strainer backwash.

USGenNE is authorized to discharge at the Deerfield No.2 Station via four outfalls to the Deerfield River in Buckland (NPDES MA0034843 permit issued in September 1997). The discharges are as follows:

- Outfall 001: 0.0015 MGD of internal facility drainage,
- Outfall 002: 0.06 MGD non-contact transformer cooling water,
- Outfall 003: 0.0216 MGD bearing cooling water, and
- Outfall 004: 0.0432 MGD cooling water strainer backwash.

Consolidated Edison Energy Massachusetts, Inc. is authorized to discharge from the Gardner Falls Station (NDPES permit MA0035670 issued in September 1997) to the Deerfield River near the Deerfield No. 3. canal discharge in Buckland. The discharges are as follows:

- Outfall 001: 0.00864 MGD of bearing cooling water, and
- Outfall 002: 10 GPD boiler blowdown (90°F maximum).

The Town of Buckland is authorized to discharge from the Shelburne Falls Wastewater Treatment Facility to the Deerfield River off of Gardner Falls Road in Buckland (NPDES permit MA0101044 issued in December 2003). The permittee is authorized to discharge 0.25 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes chlorine for disinfection (TRC shall not exceed 1 mg/L).

The Town of Deerfield is authorized to discharge from the Old Deerfield Wastewater Treatment Facility to the Deerfield River off of Little Meadow Road in Deerfield (NPDES permit MA0101940 issued in December 2003). The permittee is authorized to discharge 0.25 MGD of treated sanitary wastewater via Outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 50\%$ with a monitoring frequency of twice per year. The facility utilizes chlorine for disinfection (TRC shall not exceed 1 mg/L).

OTHER

Hydropower (Federal Energy Regulatory Commission- FERC)

The Deerfield River Hydroelectric System along this segment of the Deerfield River is comprised of two FERC licensed projects; one owned by USGenNE, Inc. (FERC L.P. No. 2323) and the second owned by Consolidated Edison Energy Massachusetts, Inc. (FERC L.P. No. 2334). FERC L.P. No. 2323 consists of three developments in Vermont and five developments in Massachusetts, two of which are located in this segment of the Deerfield River and one which straddles this segment and the upstream Segment MA33-02). The FERC license for project No. 2323 was reissued in April 1997. There is one development on this segment of the Deerfield River authorized by FERC L.P. No. 2334 (This license was issued in 1997.).

- The most upstream hydropower development in this segment of the Deerfield River is the outfall from the Deerfield No. 4 development FERC L.P. No. 2323. The Deerfield No. 4 Development is located on the Deerfield River in Buckland/Charlemont (Segment MA33-02). This development has a power tunnel that conveys water from the intake structure at the impoundment via a 12.5-foot diameter, 1,514 feet long concrete and brick-lined horseshoe-shaped tunnel to a powerhouse. The powerhouse contains three horizontal Francis turbine units with a capacity of 1,600 KW each and a total hydraulic capacity of 1,490 cfs (FERC 1997). The power canal tunnel cuts through a bend in the river, which bypasses approximately 1.4 miles of the Deerfield River (the lower 0.9 miles of Segment MA33-02 and the upper 0.5 miles of this segment). A minimum flow of 100 cfs or inflow, whichever is less, is required from 1 October to 31 May and 125 cfs or inflow, whichever is less, is required from 1 June to 30 September at this development to the mainstem Deerfield River.
- The second development in this segment of the Deerfield River is the Deerfield No. 3 Development in Buckland/Shelburne located approximately 1.3 miles downstream from the outfall of the No. 4 Development. Deerfield No. 3 Development, also authorized by FERC L.P. No. 2323, includes a concrete dam 475 feet long, 15 feet high topped with six-foot-high wooden

flashboards that can impound a surface area of about 42 acres (FERC 1997). This development has a 677 -foot long (0.1 mile) power canal located to the west of the Deerfield River. Water from the Deerfield No. 3 Dam is diverted into the power canal and is conveyed to the powerhouse that holds three horizontal Francis turbine units with a capacity of 1,600 KW each, and a total hydraulic capacity of 1,490 cfs. The power canal bypasses approximately 0.4 miles of the Deerfield River. A minimum flow of 100 cfs or inflow, whichever is less, is required at this development year round. This facility is also obligated to provide downstream fish passage.

- The third development in this segment of the Deerfield River is the Gardner Falls Project, which is located on the Deerfield River in Buckland/Shelburne approximately 0.9 miles downstream from the Deerfield No. 3 Dam. This facility operates under FERC L.P. No. 2334. The development consists of a dam that is 30 feet high and 337 feet long and impounds about 0.6 miles of river with a surface area of approximately 21 acres. Water from the dam is diverted to the powerhouse via a 1,300 feet long (0.25 mile) power canal located to the west of the Deerfield River. The power canal bypasses approximately 0.3 miles of the Deerfield River. The powerhouse contains four turbine-generator units with a total generating capacity 3.58 MW. The total hydraulic capacity of these turbines is 1520 cfs. A minimum flow of 150 cfs or inflow, whichever is less, is required to be released to the mainstem Deerfield River at this development year-round. This facility is also obligated to provide downstream fish passage. Flows necessary for the operation of this fish bypass (150 cfs) should be provided during the periods of downstream migration (1 April to 15 June and 15 September to 15 November).
- The fourth development in this segment of the Deerfield River is the Deerfield No. 2 Development in Conway/Shelburne located approximately 1.9 miles downstream from the Gardner Falls Project Dam. Deerfield No. 2 Development, also authorized by FERC L.P. No. 2323, includes a concrete dam 447 feet long, 70 feet high topped with six-foot-high wooden flashboards and four sluice gates that can impound about 1.5 miles of the river with a surface area of about 63.5 acres (FERC 1997). There is a powerhouse located adjacent to the Deerfield No.2 Dam, which contains three horizontal Francis turbine units with a capacity of 1,600 KW each and a total hydraulic capacity of 1450 cfs. A minimum flow of 200 cfs is required year-round. This development is also required to provide downstream fish passage. Upstream passage of adult Atlantic salmon will be required in the future if the target return threshold of four adult salmon has been attained for two consecutive years at the dam.

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified seven historic landfills in this segment: Buckland Wood and Demolition Landfill, Lampson & Goodnow Manufacturing Company, Former Buckland Landfill, Former Conway/Buckland Landfill (Shelburne Town Landfill), Greenfield Landfill, Greenfield Tire Pile, Shelburne Stump/Brush Dump. These sites can be summarized as follows.

- The <u>Buckland Wood and Demolition Landfill</u> is over 25 years old and received demolition waste, including asbestos. The landfill is capped but not lined. It lies within 500 feet of the Deerfield River and one half mile of a public water supply and an Interim Wellhead Protection Area (IWPA). Fuss and O'Neill (2003) recommended this site for screening level sampling due to its proximity to and potential to impact sensitive environmental receptors. Issues identified from this study included exposed brush, bulky waste, tires and miscellaneous household waste on a steep slope, groundwater seeps with discoloration and oily sheen at the base of the landfill, which is hydraulically connected to the Deerfield River via a small unnamed tributary. This tributary contained elevated levels of cadmium and manganese and high pH.
- The <u>Lampson & Goodnow</u> site is over 25 years old. This company manufactures cutlery. A former waste disposal area is believed to be located behind the manufacturing building adjacent to the Deerfield River. Since this was never an officially recognized landfill no information exists in MA DEP's files. Fuss and O'Neill (2003) recommended this site for screening level sampling due to its proximity to and potential to impact sensitive receptors. Results from a soil sample collected at the location of the former process discharge indicate a chromium concentration of approximately 35,200 mg/kg, which exceeds the Massachusetts Reportable Concentration value of 1,000 mg/kg.

- The Former Buckland Landfill is over 25 years old and accepted municipal solid waste and possibly industrial waste from Lampson & Goodnow. No daily cover was used and open burning occurred. The Buckland WWTP was constructed in 1974 on top of this site. There is a public water supply and an IWPA within one-half mile and the Deerfield River is about 100 feet away. The site was recommended for screening level sampling by Fuss and O'Neill (2003) due to its proximity to and potential to impact sensitive receptors. Sampling revealed no visual evidence of exposed refuse, erosion or litter. A downgradient groundwater seep exhibited only minor exceedances of the Massachusetts Drinking Water Standard for iron and manganese, both of which are naturally-occurring metals. Most of the tested parameters were non-detect. Additional investigation of the site was not recommended.
- The Former Conway/Buckland Landfill (Shelburne Town Landfill) is also over 25 years old and received municipal solid waste. The landfill is not lined, but it is capped. The site lies on a steep hill on the banks of the Deerfield River and is within one-half mile of a public water supply and an IWPA. The site was recommended for screening level sampling due to its proximity to and potential to impact sensitive environmental receptors. Sampling revealed a large area with a significant quantity of exposed refuse on a very steep slope. Bulky waste is scattered up to 200 feet downgradient of the base of the landfill. Groundwater seeps contained elevated levels of lead, cadmium, copper, and mercury, based on the results of a screening level seep sample. Surface drainage does not appear to be impacted by landfill leachate based on the results of the surface water sample collected from the drainage ditch outfall pipe.
- The Greenfield Landfill is well over 25 years old – the site has been used for municipal solid waste disposal since 1928. It has also accepted, over the years, industrial waste (some hazardous), sludge from the Greenfield WWTP, ash, petroleum contaminated soils, wood waste, and asbestos. The site is capped and partially lined. Extensive environmental monitoring has been conducted at the site since 1982. Consequently, the site was not recommended for screening level sampling by this study.
- The Greenfield Tire Pile site is comprised of approximately 3,000 to 4,000 tires that lie in a ravine along the banks of the Deerfield River. Screening level sampling was not recommended for this site.
- The Shelburne Stump/Brush Dump is less than 25 years old and was used for disposal of wood waste, demolition material, household appliances and refuse, tires and metal. It is capped but not lined. It was not recommended for screening level sampling under this study.

USE ASSESSMENT SUMMARY

AQUATIC LIFE

Habitat and Flow

Please refer to the earlier descriptions of flow regulation imposed by the hydroelectric power developments in this segment.

According to USGS (remarks noted from their gaging station records on the Deerfield River near West Deerfield - 01170000) flows are regulated by Somerset Reservoir, since 1924 by Harriman Reservoir, and by several hydro-electric powerplants upstream. The drainage area at this gage is 557 mi^2. Data from the USGS gage revealed that the 2000 water year annual mean flow (1,709 cfs) was greater than the mean annual flow for the 96-year period of record (1,318 cfs) (Socolow *et al*. 2001). The estimated 7Q10 flow at the gage is 95.6 cfs (USGS 2003). With the renewed FERC licenses now in place for the hydropower projects upstream from the gage this estimate should increase because of the 200 cfs minimum flow required at the Deerfield No. 2 Project.

The Deerfield River was sampled by DWM downstream from Stillwater Bridge in Deerfield (Station LDR01) in September 2000. At the time of the survey the river was roughly 35 m wide with depths ranging from 0.3 to $\geq$1.0 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 192 (Appendix B). Habitat quality was limited most by velocity/depth combinations.

Biology
Compared to the Cold River reference station (Station CR01) the RBP III analysis indicated the benthic community was non-impacted in the Deerfield River downstream from Stillwater Bridge in Deerfield (Station LDR01) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in 1988 and 1995 (Appendix C).

DWM biologists collected periphyton samples from Station LDR01, located downstream from Stillwater Bridge, Deerfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% percent and algal cover was 90%. The dominant algal type and form were greens/thin film. No nuisance algal growth (filamentous green algae) was documented (Appendix D).

Toxicity
Ambient
Water from the Deerfield River was collected approximately 300 feet upstream from the Shelburne Falls Wastewater Treatment Facility discharge (Outfall #001) in Shelburne for use as dilution water in the facility's whole effluent toxicity tests. Eleven acute toxicity tests using *C. dubia* and *P. promelas* were conducted between April 1998 and April 2003. Survival of both test organisms exposed (48-hours) was greater than 90% in all tests conducted.

Water from the Deerfield River was collected approximately 250 feet upstream from the Old Deerfield Wastewater Treatment Plant discharge (Outfall #001B) in Deerfield for use as dilution water in the facility's whole effluent toxicity tests. Survival of *C. dubia* exposed (48-hours) to the river water was not less than 90% in the 13 tests conducted between October 1996 and 2002.

Effluent
Eleven definitive acute whole toxicity tests were conducted on the Shelburne Falls Wastewater Treatment Facility effluent using *C. dubia* and *P. promelas* between April 1998 and April 2003. The effluent was not acutely toxic (LC_{50} >100%) to either species during this period.

A total of 13 definitive acute whole effluent toxicity tests were conducted on the Old Deerfield WWTF effluent using *C. dubia* between October 1996 and October 2002. The effluent was not acutely toxic (LC_{50} >100%) to *C. dubia* during this period.

Chemistry-water
Water from the Deerfield River was collected approximately 300 feet upstream from the Shelburne Falls WWTP discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on 11 occasions between April 1998 and April 2003. Water from the Deerfield River was collected approximately 250 feet upstream from the Old Deerfield WWTP discharge for use as dilution water for the facility's whole effluent toxicity tests, as required by their NPDES permit, on 13 occasions between October 1996 and October 2002. Data from these reports, which are maintained in the TOXTD database by DWM, are summarized for the period indicated in parentheses below.

Water quality sampling was conducted by DWM at one location from this segment of the Deerfield River (approximately 2000 feet downstream from the Stillwater Bridge in Deerfield – Station LD) monthly between June 1995 and April 1996 (n = 13). These data are presented in Appendix G, Tables G3 and G4.

Water quality samples were also collected from the Deerfield River just upstream of the confluence with the Green River in Greenfield (station DW12) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The Deerfield River Watershed Association (DRWA) performs volunteer water quality monitoring for pH, DO, alkalinity, and temperature in this segment of the Deerfield River at two stations: upstream from the Gardner Falls Hydroelectric Project, Buckland (DER-016) and near the Stillwater Bridge in

West Deerfield (DER-015). Samples were collected once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

DO and % saturation
DO in the Deerfield River just upstream from the confluence with the Green River in Greenfield (Station DW12) measured by ESS in 2000 ranged from 9.28 to 11.78 mg/L and saturation was not less than 83.3% during the sampling events conducted. It should be noted that these data do not represent worst-case conditions.

Temperature
The maximum temperature in this segment of the Deerfield River recorded by ESS in 2000 was 20.5°C (ESS 2002).

pH and Alkalinity
The pH of the Deerfield River upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 6.2 and 7.6 SU (only one of the 11 measurements reported was less than 6.5 SU) and upstream from the Old Deerfield WWTP discharge ranged from 6.5 to 7.7 SU (recorded in the TOXTD database between October 1996 and October 2002). Alkalinity measurements upstream from Shelburne Falls WWTF ranged from 10 to 60 mg/L and upstream from the Old Deerfield WWTP discharge ranged from 7 to 82 mg/L. The pH of the Deerfield River just upstream from the mouth of the Green River (Station DW12) ranged from 6.8 to 7.0 SU (ESS 2002).

Specific Conductance
Conductivity measurements in the Deerfield River upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 53 and 75 µS/cm and upstream from the Old Deerfield WWTP discharge ranged from 53 to 136 µS/cm (recorded in the TOXTD database between October 1996 and October 2002). Measurements in the river near the confluence with the Green River (Station DW12) ranged from 54.2 to 90.3 µS/cm (ESS 2002).

Suspended Solids
The highest reported suspended solids concentration in this segment of the Deerfield River was 22 mg/L (recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP).

Ammonia-Nitrogen
The highest reported ammonia-nitrogen concentration in this segment of the Deerfield River was 0.2 mg/L (recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP). None of the measurements exceeded the WQC.

Total Residual Chlorine
None of the 24 TRC measurements recorded in the TOXTD database for Shelburne Falls WWTF and Old Deerfield WWTP were above the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements upstream from the Shelburne Falls WWTF discharge (recorded in the TOXTD database between April 1998 and April 2003) ranged between 12 and 60 mg/L and upstream from the Old Deerfield WWTP discharge ranged from 11 to 36 mg/L (recorded in the TOXTD database between October 1996 and October 2002). Only four of the 24 hardness measurements were greater than 25 mg/L.

<u>Chemistry - sediment</u>
Three sediment grab samples were collected and composited from three locations on this segment of the Deerfield River in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic

carbon), percent volatile solids, percent water, and grain size. The sampling station locations and the results of these analyses are summarized as follows.

- Station DWS-3 - behind USGenNE's Deerfield No.3 Dam in Buckland/Shelburne. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 10.7 ppm, which is approximately 1.8 times greater than the L-EL. The sediment was comprised primarily of medium sand (72%) and fine sand (19.6%). No PAH, TPH, VS or PCB were detected.
- Station DWS-4 - behind ConEdison's Gardner Falls Dam in Buckland/Shelburne. With the exception of arsenic and lead, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 10.3 ppm, which is approximately 1.7 times greater than the L-EL and the lead concentration was measured at 43.5 ppm, which is approximately 1.4 times greater than the L-EL, although the replicate lead analysis was low (8.5 ppm). The sediment was comprised primarily of medium sand (70%) and fine sand (21.6%). TPH were detected (41 ppm). No PAH, VS or PCB were detected.
- Station DWS-5 - behind USGenNE's Deerfield No.2 Dam in Conway/Shelburne. With the exception of arsenic, all analytes fell below the low effects range (L-EL) as defined by Persaud et al. 1993. The arsenic concentration was measured at 16.3 ppm, which is approximately 2.7 times greater than the L-EL. The sediment was comprised primarily of fine sand (69.1%) and silt and clay (17.9%) and the total volatile solids was 2.2% by weight. No PAH, TPH, or PCB were detected.

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community analysis, high survival of test organisms exposed to the river water, the water quality data, and with the exception of arsenic, the limited sediment quality data. The concentration of arsenic in sediment samples collected behind the Deerfield No.3 Gardner Falls, and Deerfield No.2 dams in this segment of the Deerfield River were slightly elevated, but is due likely to natural background conditions typical of sediment from New England freshwater rivers (ESS 2002). This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users regarding flow regulation (hydromodification) resulting from the operations of the hydroelectric generating facilities (EOEA 2001, 2002, 2003 and 2004). It is USGen New England, Inc.'s first priority to continue to operate hydro facilities on the Deerfield River in accordance with the FERC licenses, the Offer of Settlement and the Massachusetts Water Quality Certificate. However, the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria approximately 2000 feet downstream from the Stillwater Bridge in Deerfield (Station LD) between June 1995 and June 1996 (n = 11) (Appendix G, Table G4).

Fecal coliform bacteria sampling was conducted by the DRWA at five locations in this segment of the Deerfield River between June and August 2001 and 2002 (DRWA 2001 and DRWA 2002).

- At the glacial potholes in Shelburne Falls (Station DER-018) (n = 5 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 39 to 600 colonies/100 mL (only one wet weather sample exceeded 400).
- At Wilcox Hollow in Shelburne (Station DER-019) (n = 6 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 6 to 400 colonies/100 mL.
- At South River confluence in Conway (Station DER-014) (n = 6 wet weather and 5 dry weather sampling events). Fecal coliform counts at this station ranged from 8 to 800 colonies/100 mL (three counts exceeded 400, all associated with wet weather).
- At Stillwater in Deerfield (Station DER-015) (n = 5 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 12 to 740 colonies/100 mL (only one count exceeded 400 and was associated with wet weather).
- At Deerfield Academy in Deerfield (Station DER-012) (n = 4 wet weather and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 17 to 114 colonies/100 mL.

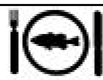
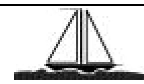
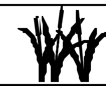
The geometric mean calculated for the fecal coliform data at each of these five stations never exceeded 200 colonies/100 mL.

Fecal coliform bacteria samples were also collected from the Deerfield River just upstream from the confluence with the Green River in Greenfield (Station DW12) on six occasions between August and November 2000 by ESS representing both dry and wet weather conditions (ESS 2002). Four of the six samples were collected during the *Primary Contact Recreation Season.* Fecal coliform bacteria counts ranged from 10 to 80 colonies/100 mL.

No objectionable deposits, odors, turbidity, or other conditions were noted by DWM biologists in 2000 (Appendix B). While turbidity has often been observed in the Deerfield River during high spring flows and after rain events, these conditions were generally considered to be a natural result of the soil types in the watershed (Averill 2002).

The *Recreational* and *Aesthetics* uses are assessed as support for Deerfield River based on the fecal coliform bacteria counts and the aesthetic conditions. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of episodic elevated bacteria counts documented by DRWA during wet weather particularly at the confluence with the South River.

Deerfield River (MA33-03) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT*	SUPPORT	SUPPORT

* "Alert Status" issues identified, see details in the use assessment section

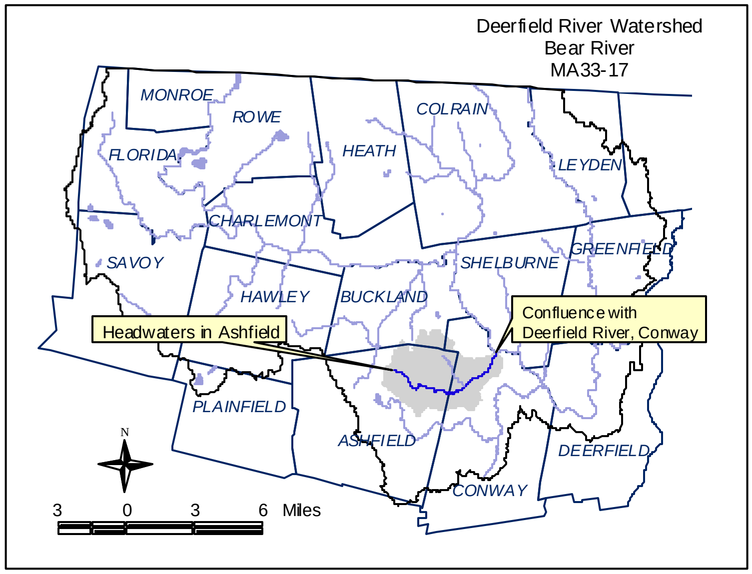
RECOMMENDATIONS DEERFIELD RIVER (MA33-03)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005). In particular, biomonitoring is recommended here to continue to assess biological health in this lower portion of the Deerfield River. Fish population sampling should accompany the macroinvertebrate sampling effort and will require multiple crews or a barge mounted electrofishing unit. Bacteria monitoring to isolate the source(s) of episodic elevated fecal coliform counts is also recommended.
- Address concerns voiced by members of the Deerfield Watershed Team that habitat and fish downstream of Deerfield Dam No. 2 may be affected by frequent water level changes and rapid ramping rates that result from hydropower production. Conduct biological surveys designed to assess impacts of hydroregulation on aquatic biota and/or pursue funding for USGS to study the effects of fluctuating water levels created by hydro-peaking on fish communities and other stream biota (Deerfield Team's FY '04 workplan priority project.)
- Work with USGen New England Inc. and settlement parties (including Massachusetts Executive Office of Environmental Affairs, Attorney General, MA DEP, MA DCR, MA DFG, US Fish and Wildlife Service, New England F.L.O.W., Trout Unlimited, and the Deerfield River Watershed Association) to ensure that releases from the hydropower dams are meeting the requirements of the FERC licenses, the Offer of Settlement, and the Massachusetts Water Quality Certification requirements.
- Two tributaries to this segment of the Deerfield River, Sluice and Hawks brooks, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, CRWC, Zoar Outdoor and Trout Unlimited.
- Work with NRCS, Massachusetts Department of Agricultural Resources and landowners to protect riparian buffers and encourage use of agricultural BMPs.
- The Towns of Buckland, Shelburne, Conway, Greenfield, and Deerfield should participate in the Deerfield River Watershed Regional Open Space Planning Project, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments (completed June 2004). Through this project these towns can work cooperatively with

other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in this segment of the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The towns should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- As part of the five-year review process, MA DEP should continue to carefully monitor Deerfield Fire District's compliance with their WMA registration limit (close to exceeding registration threshold).
- Support the recommendations of the Fuss and O'Neill (2003) landfill assessment study.
  - For management of the Buckland Wood and Demolition Landfill additional field investigation is recommended to further assess the environmental risk posed by the landfill, identify and characterize the extent of any impacts that may be present, and determine the need for corrective/remedial action. Field measurement of hydraulic conductivity, depth to groundwater, confirmation of groundwater flow rate and direction, and collection of upgradient and downgradient groundwater samples and additional seep sampling should be performed.
  - For the Lampson & Goodnow site additional investigation is recommended to address potential contamination associated with the former process wastewater discharge and identified waste disposal area behind the manufacturing building. The vertical and lateral extent of impacted soils in the area should be delineated and remedial alternatives should be identified. Additional inspection and sampling of the historical waste disposal area is also recommended to further identify the nature and extent of the waste.
  - At the Former Conway/Buckland Landfill additional field investigation is recommended to further assess the environmental risk posed by the landfill, to identify and characterize the extent of any impacts that may be present, and to determine the need for corrective action. Field measurement of hydraulic conductivity, depth to groundwater, confirmation of groundwater flow rate and direction, and collection of upgradient and downgradient groundwater samples and additional seep sampling should be performed.
  - The Greenfield tire pile is now serving as a crude form of bank stabilization, but due to its size and proximity to the Deerfield River the tire pile should be removed and the ravine should be stabilized to reduce the potential for erosion and sedimentation in the Deerfield River. This effort should be coordinated with the Greenfield Board of Health and the property owner.

BEAR RIVER (SEGMENT MA33-17)
Location: Headwaters, west of Barnes Road, Ashfield, to confluence with Deerfield River, Conway.
Segment Length: 6.9 miles.
Classification: Class B.



The drainage area of this segment is approximately 11.78 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	79.2%
Agriculture	11.7%
Open Land	4.9%

The headwaters of the Bear River begin in Ashfield just east of Ridge Hill. The newly formed river flows through a golf course, where it is impounded, and then continues in a southeasterly direction until it passes into Conway. There it changes direction, flowing to the northeast. After passing under the Shelburne Falls Road the river enters a very steep valley before its confluence with the Deerfield River in Conway.

MA DFWELE has proposed that the Bear River be protected as a cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow

The Bear River was sampled by DWM upstream of Shelburne Falls Road in Conway (Station VP11BEA) in September 2000. At the time of the survey the river was roughly 10 m wide with depths ranging from 0.1 m to 0.5 m. The substrates were comprised primarily of boulder and cobble. The overall habitat score was 176 (Appendix B). Habitat quality was limited most by the small riparian zone width on the right bank and some limitations related to velocity/depth combinations.

Biology

The benthic sample collected by DWM from the Bear River upstream from Shelburne Falls Road in Conway (Station VP11BEA) in September 2000 was used as the reference station condition for the 2000 Deerfield River Watershed Biomonitoring Survey (Appendix B). Given its status as a reference condition the benthic community was considered to be non-impacted. Macroinvertebrate biomonitoring was also conducted at this station in the Bear River (Station BR01) in 1995 (Appendix C). As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were also collected by DWM biologists from the Bear River upstream of Shelburne Falls Road in Conway (Station VP11BEA) on 6 September 1996, 24 September 1997 (MA DEP 1996b and MA DEP 1997).

The fish population in the Bear River was sampled upstream and downstream from the confluence of Drakes Brook near Shelburne Falls Road, Conway (Stations VP12BEA and VP11BEA, respectively), in September 1996 as part of the Biocriteria Development Project (MA DEP 1996b and MA DEP 1997). Sampling upstream of the confluence (Station VP12BEA) resulted in the collection of brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), slimy sculpin (*Cottus cognatus*) and Atlantic salmon (*Salmo salar*). Multiple age classes of Atlantic salmon, brook and brown trout were present. These same species, less the slimy sculpin, were documented in sampling conducted on 25 September 1997. The fish sample at VP11BEA in September 1996 and September 1997 was comprised of longnose dace *(Rhinicthys cataractae)*, slimy sculpin, blacknose dace, Atlantic salmon, creek chub *(Semotilus atromaculatus)*, brook trout and brown trout. Multiple age classes of Atlantic salmon and brook trout were collected. Four species are considered intolerant of pollution (MA DEP 1996b and MA DEP 1997). All fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species, and the absence of macrohabitat generalists indicated excellent habitat and water quality conditions as well as stable flow regimes. MA DFWELE also conducted fish population sampling in the Bear River at two locations upstream from Drakes Brook in August 2000. Brook trout, blacknose dace, Atlantic salmon, brown trout, longnose dace and pumpkinseed (*Lepomis gibbosus)* were present with multiple age classes present. In August 2001 Atlantic salmon, brook trout, brown trout (all with multiple age classes) were present (Richards 2003).

DWM biologists collected periphyton samples from Station VP11BEA, located upstream approximately 100 m from Shelburne Falls Road, at the same time as the September 2000 survey. Canopy cover was reported as 75% and percent algal cover was 50%. The dominant algal type and form were greens/filamentous, thin film. No nuisance algal growth (green filamentous algae) was documented. (Appendix D)

<u>Chemistry-water</u>
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) of the Bear River upstream from the confluence with Drakes Brook and downstream from the confluence with Pea Brook in Conway (Stations VP12BEA and VP11BEA, respectively) were made on 17 September 1996 and 25 September 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). DWM also collected water quality samples from the Bear River upstream from the bridge on Shelburne Falls Road in Conway (Station BE) between July 1995 and June 1996 (n = 12) and two upstream locations (Station BR03 and BR02) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

The *Aquatic Life Use* is assessed as support based on the benthic macroinvertebrate community (reference station) and fish population information.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS
DWM collected fecal coliform bacteria samples from the Bear River upstream from the bridge on Shelburne Falls Road in Conway (Station BE) between July 1995 and June 1996 (n = 12) and two upstream locations (Stations BR03 and BR02) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4).

No aesthetic quality degradation (odors, turbidity, oil, grease) or any other objectionable conditions were noted by DWM biologists during their surveys in the Bear River in 1996, 1997 or 2000.

Although too limited current bacteria data are available to assess the recreational uses the *Aesthetics Use* is assessed as support.

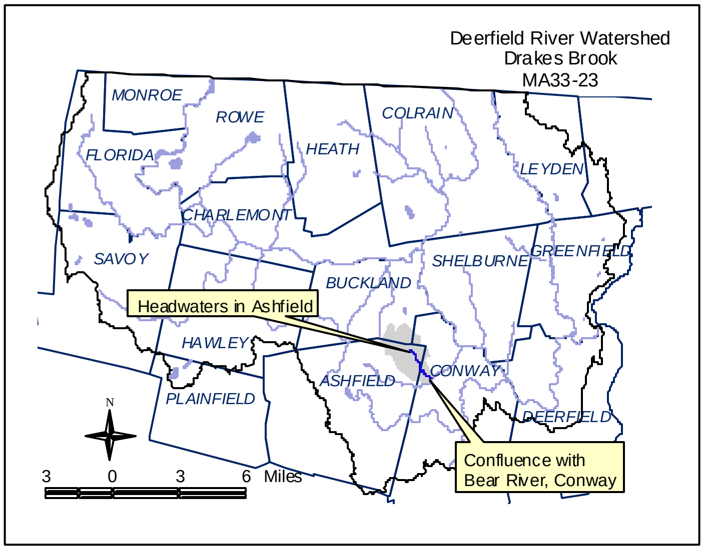
Bear River (MA33-17) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS BEAR RIVER (MA33-17)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005). In particular, as a reference condition biomonitoring is recommended here especially if evaluations of first to third-order stream biota are planned. Fish population sampling should accompany the macroinvertebrate sampling.
- The Bear River should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- The Towns of Ashfield and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Bear River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Ashfield and Conway should support recommendations of the recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Bear River subwatershed identified and mapped patches of this plant growing along the 3.4 km of the river that was surveyed between Pfersick Road and Shelburne Falls Road and where the Bear River flows into the Deerfield River. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- DRWA volunteers conducted a stream continuity survey in the fall of 2002 with the help of UMass Extension that identified many barriers to fish and wildlife in the Bear River subwatershed (Walk 2003). Support efforts of towns, local groups and state agencies (Riverways, MassHighway) to reduce frequency and impact of these barriers to stream biota.

DRAKES BROOK (SEGMENT MA33-23)
Location: Headwaters, west of North Warger Road, Ashfield, to confluence with Bear River, Conway.
Segment Length: 2.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 3.46 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	84.7%
Agriculture	8.1%
Residential	2.9%

The Drakes Brook headwaters begin on the southeastern slope of Moonshine Hill in Buckland. These headwaters converge 0.35 miles northeast of Baptist Corner Road, Buckland. The brook then flows southeast under this road, and through an area of gravel extraction. Drakes Brook merges with Sids Brook just south of the Village of Shirkshire in Buckland. From there Drakes Brook joins the flow of the Bear River just before passing under South Shirkshire Road, Buckland.

MA DFWELE has recommended that Drakes Brook be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow
One stream reach in Drakes Brook was sampled by DWM biologists between September 1996 and September 2000. The reach was located upstream from the confluence with the Bear River off South Shirkshire Road, Conway (Station VP13DRK), and was surveyed as part of the MA DEP Biocriteria Development Project in September 1996, 1997 and 2000 (Appendix B and MA DEP 1996b and MA DEP 1997). At the time of the survey in September 2000 the river was roughly 4 m wide with depths ranging from 0.1 to 0.3 m in the riffle areas. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 183 (Appendix B). Habitat quality was limited most by slight limitations related to velocity/depth combinations.

Biology
As part of the MA DEP Biocriteria Development Project benthic macroinvertebrate samples were collected by DWM biologists from Drakes Brook upstream from the confluence with the Bear River off South Shirkshire Road, Conway (Station VP13DRK) on 6 September 1996, 24 September 1997 and again on 27 September 2000 (Appendix B and MA DEP 1996b and MA DEP 1997). The fish population in Drakes Brook (Station VP13DRK) was comprised of, in order of abundance, blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), slimy sculpin (*Cottus cognatus*), brook trout (*Salvelinus fontinalis*), longnose dace *(Rhinichthys cataractae)*, brown trout (*Salmo trutta*), and a brown bullhead (*Ameiurus nebulosus*) in September 1996. With the exception of the brown bullhead all of these species were captured in the same stream reach in September 1997 and Atlantic salmon (*Salmo salar*) and a *Lepomis* sp. were also documented (MA DEP 1996b and MA DEP 1997). A total of four fish species present in the brook are considered intolerant of pollution. With the exception of brown bullhead all fish species collected in this brook are fluvial specialists/dependants. The presence of multiple age classes of brook trout and Atlantic salmon, multiple intolerant species,

and the dominance by fluvial dependant/specialists indicated excellent habitat and water quality conditions as well as stable flow regimes. MA DFWELE also conducted fish population sampling in Drakes Brook at one location upstream from Baptist Road in Conway in August 2000. Fish species present in order of abundance were: multiple age classes of brook trout, blacknose dace, and one each of brown trout and slimy sculpin. In August 2001, MA DFWELE also conducted fish sampling near South Shirkshire Road in Shelburne. Fish species collected in order of abundance included: brook trout, Atlantic salmon and brown trout (all with multiple age classes) (Richards 2003).

Chemistry-water

DWM sampled one station on Drakes Brook in Conway (Station VP13DRK) on 25 September 1996 and 8 October 1997 as part of the MA DEP Biocriteria Development Project (Appendix G, Table G3). *In-situ* measurements included DO, %saturation, pH, temperature, conductivity, and turbidity.

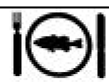
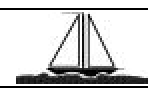
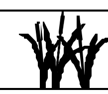
The *Aquatic Life Use* in Drakes Brook is assessed as support based primarily on the fish population information and best professional judgment. The presence of multiple age classes of brook and rainbow trout is indicative of excellent habitat and water quality. Furthermore, these fish are fluvial specialists, which suggests that the flow regime has not been compromised in this brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Drakes Brook during any of the three sampling events conducted by DWM biologists as part of the Biocriteria Development Project between September 1996 and September 2000 (Appendix B, MA DEP 1996b and MA DEP 1997).

Although no bacteria data are available to assess the *Recreational* uses the *Aesthetics Use* is assessed as support.

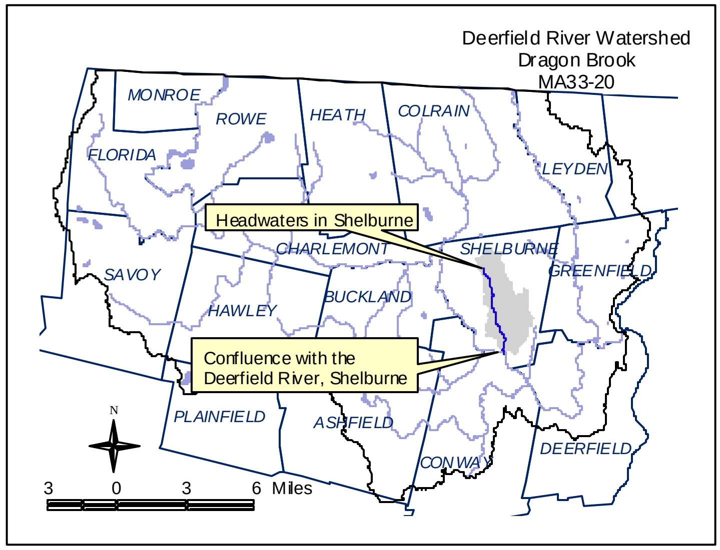
Drakes Brook (MA33-23) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

RECOMMENDATIONS DRAKES BROOK (MA33-23)

- Continue DWM water quality and biological monitoring in this segment during the next assessment monitoring year (2005) to more completely assess the designated uses.
- Drakes Brook should be protected as cold water fishery habitat.
- Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable to investigate possible impact of salmon stocking on the brook trout population.
- The Towns of Buckland and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans these towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Drakes Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Towns of Buckland and Conway should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- DRWA volunteers conducted a stream continuity survey in the fall of 2002 with the help of UMass Extension that identified many barriers to fish and wildlife in the Bear River subwatershed including Drakes Brook (Walk 2003). Support efforts of towns, local groups and state agencies (Riverways, MassHighway) to reduce frequency and impact of these barriers to stream biota.

DRAGON BROOK (SEGMENT MA33-20)
Location: Headwaters, north of Patten Road, Shelburne, to confluence with the Deerfield River, Shelburne.
Segment Length: 4.4 miles.
Classification: Class B.



The drainage area of this segment is approximately 6.25 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	60.5%
Agriculture	21.4%
Open Land	9.3%

The headwaters of Dragon Brook begin on the southeastern slope of Patten Hill in Shelburne. The brook flows south where it receives the flow from an un-named stream in Shelburne Center. The brook then parallels Bardwell Ferry Road as it continues in a southerly direction. Dragon Brook receives the flow from Hawkes Brook approximately 0.65 miles upstream of the confluence of Dragon Brook and the Deerfield River.

MA DFWELE has recommended that Dragon Brook and its tributary Hawkes Brook be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow

Dragon Brook was sampled by DWM biologists in September 1996 downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths up to 0.25 m. The substrates were comprised primarily of boulder, cobble and gravel. The overall habitat score was 143 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, the velocity/depth combinations, the lack of instream cover for fish and the riparian vegetative zone width.

Biology

Dragon Brook was sampled by DWM biologists downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) as part of the DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured in order of abundance included: blacknose dace (*Rhinichthys atratulus*), brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) (MA DEP 1996b). Multiple age classes of both brook and brown trout were present. Brook and brown trout are both intolerant fluvial dependant species and their presence is indicative of excellent water and habitat quality conditions as well as a stable flow regime.

Chemistry-water

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Dragon Brook were taken upstream and downstream from Bardwell Ferry Road in Shelburne (Station VP01DRG) on 24 September 1996 (Appendix G, Table G3).

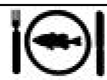
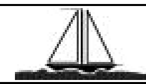
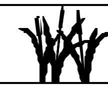
Although the fish community is indicative of excellent water quality and habitat conditions, because of the lack of sufficient recent water quality and biological data the *Aquatic Life Use* is not assessed for Dragon Brook.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Dragon Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses so they are not assessed.

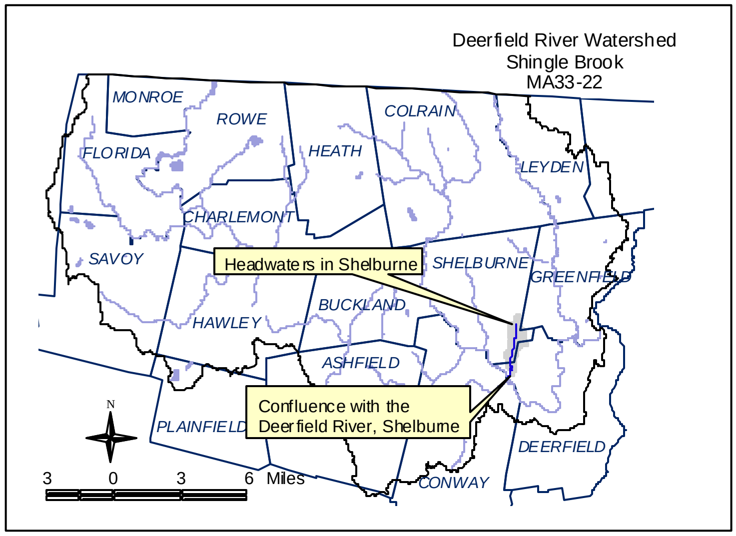
Dragon Brook (MA33-20) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS DRAGON BROOK (MA33-20)

- Conduct DWM water quality and biological monitoring in this segment to assess designated uses during the next monitoring year (2005).
- Dragon Brook and its tributary Hawkes Brook should be protected as cold water fishery habitat.
- The Town of Shelburne should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Dragon Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Shelburne should support recommendations of the recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

SHINGLE BROOK (SEGMENT MA33-22)
Location: Headwaters, north of Guy Manners Road, Shelburne, to confluence with the Deerfield River, Shelburne.
Segment Length: 2.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 1.57 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	68.4%
Agriculture	19.7%
Open Land	8.6%

Shingle Brook begins its run to the Deerfield River just south of South Shelburne Road in Shelburne. The brook flows south, paralleling Taylor Road to its confluence with the Deerfield River.

MA DFWELE has recommended that Shingle Brook be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow
Shingle Brook was sampled by DWM biologists in September 1996 near Hawkes Road in Deerfield (Station VP02SHN) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths up to 0.25 m. The substrates were comprised primarily of cobble and gravel. The overall habitat score was 120 (MA DEP 1996b). The instream habitat was limited most by the channel flow status, velocity/depth combinations, lack of instream cover, bank stability and sedimentation.

Biology
Shingle Brook was sampled by DWM biologists near Hawkes Road in Deerfield (Station VP02SHN) as part of the DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured in order of abundance included blacknose dace (*Rhinichthys atratulus*) (n=211) and creek chub (*Semotilus atromaculatus*) (n=21) (MA DEP 1996b). Although fish abundance was high both species are considered tolerant to pollution.

Chemistry-water
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Shingle Brook near Hawkes Road in Deerfield (Station VP02SHN) were taken on 24 September 1996 (Appendix G, Table G3).

Due to the lack of sufficient water quality and biological data the *Aquatic Life Use* is not assessed for Shingle Brook, but because the fish community information may indicate degraded water quality and habitat conditions, it is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Shingle Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses so they are not assessed.

Shingle Brook (MA33-22) Use Summary Table

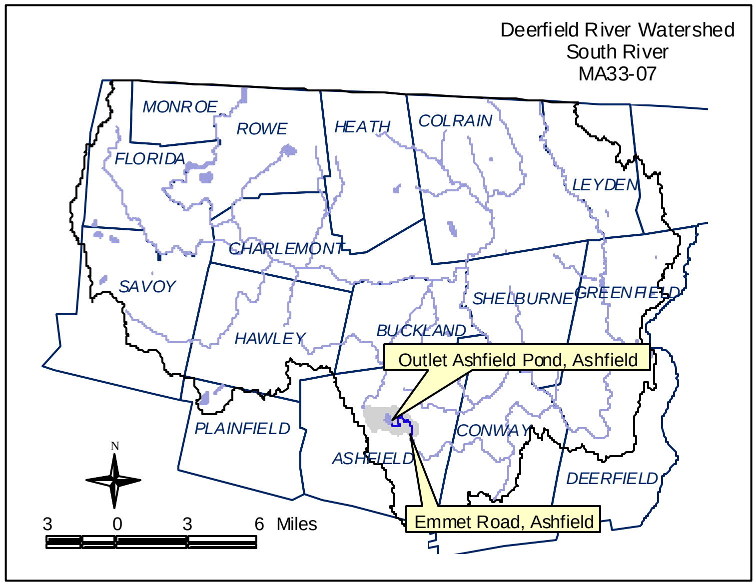
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
NOT ASSESSED *	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

*Alert Status issues identified, see details in the use assessment section

RECOMMENDATIONS SHINGLE BROOK (MA33-22)

- Conduct DWM water quality and biological monitoring in this segment to assess designated uses during the next monitoring year (2005).
- Although MA DFWELE has recommended that Shingle Brook should be protected as cold water fishery habitat, additional information (e.g., temperature, fish population, habitat quality, etc.) is needed in order to evaluate this recommendation.
- The Town of Shelburne should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Shingle Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Shelburne should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

SOUTH RIVER (SEGMENT MA33-07)
Location: Outlet of Ashfield Pond to Emmet Road, Ashfield.
Segment Length: 2.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.05 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.8%
Residential	10.6%
Agriculture	9.4%

The South River begins at the outlet of Ashfield Pond in the Town of Ashfield and flows east through part of Ashfield Center and then loops north and then southeast around part of the Center. The gradient is moderately steep and the valley narrow. Just north of Emmett Road, which marks the end of this segment, the river flows into a small impoundment and wetland.

It should be noted that sewering in Ashfield Center was completed in 1996. (See South River segment MA33-08 for a description of the facility).

MA DFWELE has recommended that the South River be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT
AQUATIC LIFE

Biology
Although these data are too old for assessment purposes it should be noted that DWM biologists conducted benthic macroinvertebrate sampling in the South River at Emmet's Road in Ashfield in 1988 (Station SOR02 in Appendix C).

Chemistry-water
In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) at four stations (SO-1, SO-2, SO-3 and SO-4) in this segment of the South River were taken on 20 July 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G3).

Water quality samples were collected from the South River at the second bridge crossing in Ashfield town center (Station DW11) on as many as six occasions between August and November 2000 by ESS (ESS 2002). These data are summarized below.

DO and % saturation
Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 8.39 mg/L or 68.3% saturation.

Temperature
The maximum instream temperature was 22.5°C.

pH
The pH ranged from 6.9 to 7.2 SU at all three locations.

Turbidity
Turbidity ranged from 0.41 to 3.00 NTU.

Conductivity
Specific conductivity measurements ranged from 151.7 to 235.0 µS/cm.

The *Aquatic Life Use* for this segment of the South River is not assessed because of the lack of sufficient water quality and biological data. Of concern, however, is a percent saturation of less than 75% and a maximum temperature measurement greater than 20°C if this river is to be protected as a cold water fishery habitat (as proposed by MA DFWELE). This use is, therefore, identified with an Alert Status because of this concern.

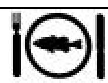
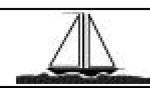
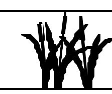
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected fecal coliform bacteria samples at four stations (SO-1, SO-2, SO-3 and SO-4) in this segment of the South River on 20 July 1995 as part of the 1995/1996 Deerfield River Watershed monitoring survey, but these data were all censored (Appendix G, Table G4).

Fecal coliform bacteria samples were collected from the South River at the second bridge crossing in Ashfield town center (Station DW11) on six occasions representing both wet and dry weather sampling between August and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts ranged from <10 to 170 cfu/100 mL.

The *Recreational* uses are assessed as support for this segment of the South River based on the low fecal coliform bacteria counts. No data are available to assess the *Aesthetics Use*.

South River (MA33-07) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED *	NOT ASSESSED	SUPPORT	SUPPORT	NOT ASSESSED

*Alert Status issues identified, see details in the use assessment section

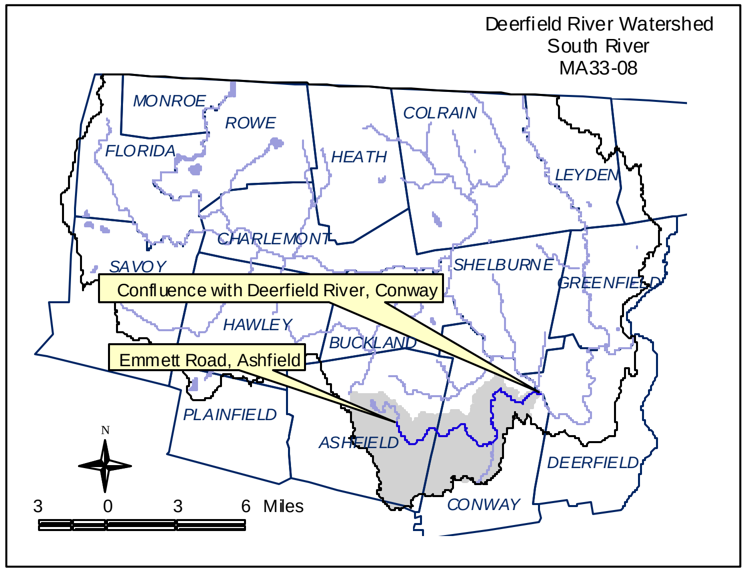
RECOMMENDATIONS SOUTH RIVER (MA33-07)

- Water quality monitoring including benthic macroinvertebrate sampling and physicochemical sampling should be conducted in this segment of the South River to document current water quality conditions and assess designated uses more completely during the next monitoring year cycle (2005).
- Additional information (e.g., fish population, instream water quality data including dissolved oxygen/percent saturation and temperature) should be collected from this segment of the South River. If appropriate, this segment should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Town of Ashfield should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the South River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the impervious cover. The Town of Ashfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and

habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped small amounts of this plant growing in the headwater segment of the river. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

SOUTH RIVER (SEGMENT MA33-08)
Location: Emmett Road, Ashfield, to confluence with Deerfield River, Conway.
Segment Length: 12.9 miles.
Classification: Class B.



The drainage area of this segment is approximately 26.37 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	77.1%
Agriculture	12.5 %
Residential	6.1%

This segment is on the 1998 303(d) List of Waters for causes unknown, other habitat alterations, and pathogens (Table 2).

From Emmett Road the South River flows south into South Ashfield where it takes an easterly direction following alongside Route 116 into Conway Center. Here the river turns north along Shelburne Falls Road and Bardwell Road, where the channel deepens and the floodplain widens allowing some agriculture, before turning east again along Reeds Bridge Road. From here to the confluence with the Deerfield River in Conway the river meanders and then flows through a deep narrow valley joined by other small streams.

MA DFWELE has recommended that the South River and several tributaries - Creamery, Chapel and Poland brooks - be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

The Town of Ashfield uses a modified design of a Solar Aquatics facility to treat its municipal wastewater which discharges to groundwater in the South River subwatershed. This facility has a groundwater discharge (permit # GW-594-0). The discharge limit from this system is 0.025MGD and the effluent must meet groundwater permit nutrient limits for total nitrogen of 10 mg/l.

USE ASSESSMENT SUMMARY
AQUATIC LIFE

Habitat and Flow

There is a small dam on the South River near Shelburne Falls Road in Conway (downstream from the town center) and approximately 1.6 miles upstream from Reeds Bridge Road crossing in Conway.

The South River was sampled by DWM upstream from Truce Road, Conway (Station SOR01) in September 2000. At the time of the survey, the river was roughly 9 m wide with depths up to 0.3 m. The substrates were comprised primarily of cobble and boulder. The overall habitat score was 170 (Appendix B). Habitat quality was limited most by sediment deposition and velocity/depth combinations.

According to USGS (remarks from gaging station records on the South River at Reeds Bridge, Conway - 01169900) diurnal fluctuation was caused by a small powerplant on the above-described upstream dam since April 1982. Data from the USGS gage revealed that the mean annual flow for 2000 (72.3 cfs) was greater than the mean annual flow (53.2 cfs) for the period of record (37 years - 1966 to present) (Socolow, *et. al*. 2001). The estimated 7Q10 flow at the gage is 3.6 cfs (USGS 2003).

Further downstream in Conway there is a 77 ft high dam on the South River located approximately 0.6 miles upstream from the confluence with the Deerfield River. The dam, known as Conway Electric Dam, lies within Conway State Forest and is now owned by MA DCR, Division of State Parks and Recreation (formerly MA DEM). It is no longer used and in disrepair but still creates a major barrier to fish. A large volume of sediment has accumulated behind the dam.

<u>Biology</u>
Compared to both the Bear River reference station (Station VP11BEA) and the Cold River reference station (Station CR01) the RBP III analyses indicated the benthic community was non-impacted in the South River upstream from Truce Road, Conway (Station SOR01) in September 2000 (Appendix B). The South River was also sampled by DWM in 1988 and 1995 upstream from Reeds Bridge Road in Conway (Appendix C). While the fish sampling efficiency at SOR01 was rated poor, fish species captured in order of abundance included; blacknose dace (*Rhinichthys atratulus*), Atlantic salmon *(Salmo salar*), longnose dace *(Rhinichthys cataractae),* common shiner *(Luxilus cornutus)*, and creek chub (*Semotilus atromaculatus*) (Appendix B). Only the Atlantic salmon and longnose dace are considered to be intolerant of pollution. Due to the sampling inefficiencies it is unclear whether the fish community was truly dominated by tolerant species. All species present are considered to be fluvial specialists/dependants, which is indicative of a stable flow regime. In addition to these species, eastern brook trout (*Salvelinus fontinalis*), slimy sculpin (*Cottus cognatus*), and a pumpkinseed (*Lepomis gibbosus),* were documented in the South River by MA DFWELE in August 2000 (Richards 2003).

DWM biologists collected periphyton samples from Station SOR01, located upstream from Truce Road, Conway, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 60% and percent algal cover was 90%. The dominant algal type and form were diatoms/thin film. No nuisance algal growth (green filamentous algae) was documented (Appendix D).

<u>Chemistry-water</u>
Water quality sampling was conducted by DWM in the South River at two locations; at the bridge at Bullitt Road in Ashfield (Station SO05) and at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway (Station SO-8). These sites were sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). The South River was also sampled near these two locations by DWM in July 1995 (Appendix G, Tables G3 and G4). Additional locations in the South River were sampled by DWM in July 1995; near Riley Road in Conway (Station SO-6), and near Conway town center at Route 116 bridge (Station SO-7). The South River near the USGS gaging station near Reeds Bridge Road in Conway was also sampled by DWM between June 1995 and June 1996 (Station SO) on 13 sampling events (Appendix G, Tables G3 and G4).

Water quality samples were also collected from two stations on this segment of the South River on as many as six occasions between August and November 2000 by ESS (ESS 2002). Station DW8 was located downgradient from the Solar Aquatics WWTF groundwater discharge, along Route 116 before Emmet Street, Ashfield. The most downstream station sampled by ESS was Station DW7 and was located at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway.

ESS also collected water quality samples in 2000 from two stations on Creamery Brook, a tributary to the South River. All of these stations were sampled six times during the study period. Station DW9 was located on Creamery Brook along Route 112, above dairy farms in Ashfield. Station DW10 was located downstream on Creamery Brook near the confluence with the South River and downstream from dairy farms in Ashfield.

The Deerfield River Watershed Association (DRWA) performed volunteer water quality monitoring in this segment of the South River at one location near Reeds Bridge Road in Conway (SOR). Samples were collected for pH, DO, alkalinity, and temperature once in April 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001and DRWA 2002).

DO and % saturation
DO levels in the South River measured by DWM and ESS in 2000 were not less than 9.3 mg/L and were as high as 13.13 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation ranged from 88.4 to a high of 100.3%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature
The maximum temperature in the South River measured by DWM and ESS in 2000 was 20°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the South River ranged between 6.9 and 7.5 SU (Appendix A, Table A8 and ESS 2002). Alkalinity of the South River ranged from 37 to 43 mg/L (Appendix A, Table A9).

Suspended Solids
Suspended solids were below detection during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were detected in the South River during the 2000 DWM surveys (Appendix A, Table A9).

Hardness
Hardness measurements of the South River ranged from 45 to 49 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the South River ranged from <0.01 to 0.016 mg/L (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the South River is assessed as support based on the benthic macroinvertebrate community analysis and the water quality data. Of concern, however, is sediment deposition and associated substrate embeddedness, which can degrade habitat quality. The fish community may also be dominated by pollution tolerant species, although sampling efficiency was poor. Because of these issues the *Aquatic Life Use* is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION

DWM collected fecal coliform bacteria samples from the South River near the USGS gaging station near Reeds Bridge Road in Conway between June 1995 and June 1996 (Station SO) (n =14) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Table G4). DWM also collected fecal coliform bacteria from three additional stations (SO-5, SO-7, and SO-8), but these data were censored.

Fecal coliform bacteria samples were collected from the South River at two stations on six occasions representing both wet and dry weather sampling conditions between August and November 2000 by ESS (ESS 2002). Results are summarized below.

- Station DW8, located downstream from Solar Aquatics along Route 116 before Emmet Street in Ashfield - fecal coliform bacteria counts ranged from 10 to 1,800 col/100 mL. One of four counts during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL (the sample was representative of wet weather conditions).
- Station DW7, located at the bridge crossing between Shelburne Falls Road and Reeds Bridge Road in Conway - fecal coliform bacteria counts ranged from 40 to >2,000 col/100 mL. One of four counts during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL (the sample was representative of wet weather conditions).

Note: Fecal coliform samples were collected in 2000 by ESS at two stations on Creamery Brook, a tributary to the South River. Creamery Brook was sampled along Route 112 above dairy farms in Ashfield (Station DW9) and near the confluence with South River, downstream from the farms in Ashfield (Station DW10). Both stations were sampled on six occasions representing both wet and dry weather conditions between August and November 2000 by ESS (ESS 2002). Results are summarized below.

- Station DW9 - fecal coliform bacteria counts ranged from 20 to 8,660 col/100 mL. None of the counts from four samples collected during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mL .
- Station DW10 - fecal coliform bacteria counts ranged from 10 to >2,000 col/100 mL. Counts from one of four samples collected during the *Primary Contact Recreational Season* exceeded 400 cfu/100 mLs (the sample was representative of wet weather conditions).

No objectionable deposits, sheens, odors or other conditions were noted during the biological monitoring survey conducted by DWM biologists in the South River in September 2000 (Appendix B) or by field crews during any of the water quality surveys conducted in 2000. It should also be noted that turbidity measurements from the South River reported by ESS (2002) were all low with the exception of one wet weather sample during the 15 September survey (54 NTU) collected at the Reeds Bridge Road in Conway (Station DW7).

The *Recreational* and *Aesthetics* uses are assessed as support for South River based on the limited fecal coliform bacteria data and the habitat quality information. The *Primary and Secondary Contact Recreational* uses, however, are identified with an Alert Status because of elevated bacteria counts documented by ESS during wet weather.

South River (MA33-08) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
SUPPORT*	NOT ASSESSED	SUPPORT*	SUPPORT*	SUPPORT

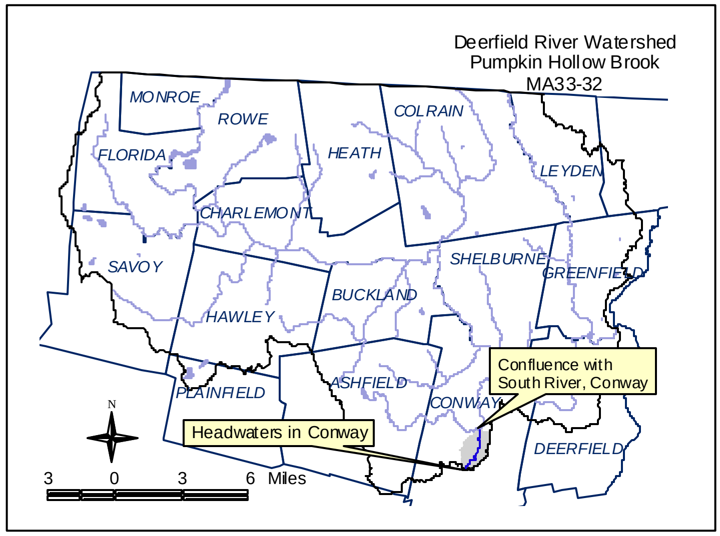
*Alert Status issues identified, see details in the use assessment section

RECOMMENDATIONS SOUTH RIVER (MA33-08)

- Work with Conway Electric Dam owner (currently MA DCR), other agencies, and the Town of Conway to explore options and funding sources for improving fish passage at this site, including possible removal or breaching of the dam.
- Water quality monitoring, including bacteria and physicochemical sampling should be conducted in this segment of the South River to identify sources of high bacteria counts during wet weather and document current water quality more completely during the next monitoring year (2005). In addition, macroinvertebrate biomonitoring is recommended along with fish population sampling using multiple crews or a barge-mounted electrofishing unit. Bacteria monitoring is also recommended for Creamery Brook to identify sources of high bacteria counts during wet weather.
- An evaluation of habitat quality conditions related to erosion and instream deposition/sedimentation in the South River should be conducted. Pursue 604b and/or 319 funding to evaluate and remediate problem areas.
- Continue to monitor the fish population in the South River. Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable.
- MA DFWELE has recommended that the river be protected as cold water fishery habitat.
- The Towns of Ashfield and Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in the South River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Ashfield and Conway should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their community's rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped large patches of this plant growing near the confluence of the South and Deerfield Rivers. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- Work with NRCS, DAR (formerly DFA) and landowners to protect riparian buffers and encourage use of agricultural BMP's.
- Encourage local stewardship efforts by supporting the DRWA volunteer water quality monitoring program.

PUMPKIN HOLLOW BROOK (SEGMENT MA33-32)
Location: Headwaters, north of Conway State Forest and south of Old Cricket Hill Road, Conway, to confluence with South River, Conway.
Segment Length: 2.3 miles
Classification: Class B.



The drainage area of this segment is approximately 1.61 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.0%
Agriculture	20.4%
Residential	10.4%

The Pumpkin Hollow Brook headwaters begin on the north slope of Cricket Hill in Conway. The brook flows north, parallel with Whately Road. Pumpkin Hollow Brook then joins the South River in Conway Center.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified two historic landfills in this segment, the Conway Landfill and the Conway Wood Waste Landfill. These landfills are both over 25 years old. It is believed that the Conway Landfill began operation around 1900. In the 1970s this dump accepted hazardous and liquid wastes and open burning was practiced. At that time a leachate plume was observed flowing from beneath the landfill, across a meadow, and into Pumpkin Hollow Brook. Sampling of surface water and groundwater were conducted on behalf of the Town of Conway by Fuss and O'Neill in July 2002. Surface water samples were collected from Pumpkin Hollow Brook upstream of the landfill and at the town swimming hole downstream of the landfill. Groundwater samples were also collected from a private well. All results were below the Massachusetts Maximum Contaminant Levels (MCLs) in the Massachusetts Drinking Water Standards according to a September 17, 2002 letter to MA DEP. This landfill is not lined but it is capped. Groundwater continues to be monitored by the town. The Conway Wood Waste Landfill received wood waste. It was closed and capped in 1991 and has been monitored since 1994. The most recent water quality results, collected in July 2002 for the town, are below MCLs of the Massachusetts Drinking Water Standards according to a September 17, 2002 letter to MA DEP. Because these sites have already been monitored, Fuss and O'Neill (2003) did not recommend these for screening level sampling under this study.

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow

Pumpkin Hollow Brook was sampled by DWM upstream from Academy Hill Road, Conway (Station PH00), in September 2000. At the time of the survey the brook was approximately 3 m wide with depths ranging from 0.25 to 0.5 m. The substrates were comprised primarily of cobble. The overall habitat score was 146 (Appendix B). Habitat quality was limited most by sediment deposition and embeddedness and by streambank instability.

Biology

Fish species captured, in order of abundance, included: creek chub (*Semotilus atromaculatus*), common shiner *(Luxilus cornutus)*, blacknose dace (*Rhinichthys atratulus)*, Atlantic salmon *(Salmo* *salar*), longnose dace *(Rhinichthys cataractae),* and a brook trout (*Salvelinus fontinalis*) (Appendix B). While two species are considered to be intolerant of pollution their numbers were extremely low and the community was dominated by tolerant and moderately tolerant species. All species collected were fluvial dependant/specialists, which are indicative of a stable flow regime.

<u>Chemistry-water</u>
Water quality samples were collected from Pumpkin Hollow Brook just upstream from its confluence with the South River in Conway (Station DW23) in October and November 2000 by ESS (ESS 2002). Results are summarized below.

DO and % saturation
Although not representative of worst-case (pre-dawn) conditions the instream DOs were not less than 11.82 mg/L or 88.4% saturation.

pH
The pH ranged between 7.0 and 7.1 SU.

Turbidity
Turbidity ranged between 0.31 and 21.1 NTU.

Conductivity
Specific conductivity measurements were 128.2 and 148.8 µS/cm.

The *Aquatic Life Use* for Pumpkin Hollow Brook is assessed as support based primarily on fish population information and best professional judgment. This use, however, is identified with an Alert Status, because of sediment deposition and associated substrate embeddedness, which can degrade habitat quality.

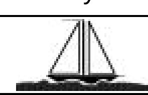
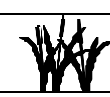
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria samples were collected from Pumpkin Hollow Brook just upstream of its confluence with the South River in Conway (Station DW23) in October and November 2000 by ESS (ESS 2002). The fecal coliform bacteria counts were 30 and 220 cfu/100 mL (both samples were representative of wet weather conditions).

The Massachusetts Department of Public Health beach closure report (MA DPH 2001b) states that the Conway Swimming Hole on Pumpkin Hollow Brook was never closed for elevated bacteria during the 2001 season.

Too limited bacteria data are available and, so the *Recreational* uses are not assessed for Pumpkin Hollow Brook. No objectionable deposits or conditions were reported at Pumpkin Hollow Brook by DWM biologists in 2000 so the *Aesthetics Use* is assessed as support.

Pumpkin Hollow Brook (MA33-32) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT

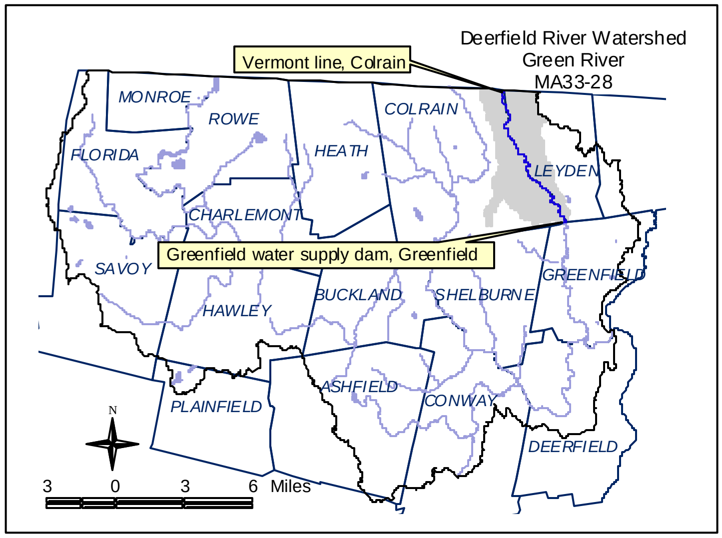
*Alert Status issues identified, see details in the use assessment section

RECOMMENDATIONS PUMPKIN HOLLOW BROOK (MA33-32)

- Water quality monitoring throughout the Pumpkin Brook subwatershed is recommended, especially nutrient and bacteria sampling to help isolate potential sources of nutrient/organic loads and to document current water quality more completely during the next monitoring year (2005). In addition, fish population sampling should be conducted along with macroinvertebrate sampling in this segment.
- An evaluation of habitat quality conditions related to erosion and instream deposition/sedimentation in Pumpkin Hollow Brook should be conducted. Pursue 604b and/or 319 funding to evaluate and remediate problem areas.
- The Town of Conway should participate in the Deerfield River Watershed Regional Open Space Plans, which were funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments and Dodson Associates. Through these plans the town can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Pumpkin Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Town of Conway should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain the communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

GREEN RIVER (SEGMENT MA33-28)

Location: Vermont line, Colrain, to Greenfield water supply dam (north of Eunice Williams Road), Greenfield (formerly part of segment MA33-09).
Segment Length: 8.5 miles.
Classification: Class B, (Cold Water Fishery).
Note: The MA DEP Drinking Water Program has recommended that this segment be reclassified as a Class A waterbody in the next revision of the Massachusetts Water Quality Standards.



The drainage area of this segment is approximately 14.8 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.2%
Agriculture	10%
Residential	4.6%

This segment (formerly part of Segment MA33-09) is on the 1998 303(d) List of Waters for causes unknown, metals and pathogens (Table 2).

The Green River flows from Vermont into Colrain, twisting southeast through a steep narrow valley, and quickly becomes the border between Colrain and Leyden. Many small streams contribute to its flow along the way. This segment ends at the Greenfield water supply dam just downstream from the Colrain/Greenfield town line near the covered bridge on Eunice Williams Drive.

The Town of Greenfield Department of Public Works is working with the Town of Guilford, VT to address concerns regarding an auto junkyard located along the banks of the Green River in Guilford, VT. The Town of Guilford has requested that vehicles be removed from the flood plain and that stormwater BMPs be implemented at this site (Shields 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
Greenfield Water Department*	1114000		10311401	Green River-03S	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY

There are no known NPDES discharges to this segment of the Green River.

OTHER

Landfills

The Deerfield River Watershed Landfill Assessment Study (Fuss and O'Neill 2003) identified an area of historic (and current) chronic dumping in this segment along Green River Road in Colrain. The area of dumping is located along the eastern side of Green River Road and the western bank of the Green River, from approximately the intersection of Nelson Road southward to the Greenfield town line. Annual river cleanups by volunteers yield mostly household appliances, household trash, construction debris, paint cans, and furniture from this area. No screening level sampling was recommended by the Fuss and O'Neill report. The Town of Greenfield is concerned about potential impact to its surface drinking water supply and has been working with several landowners to discourage access to some of the dumping spots.

ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The Greenfield water supply dam is the most upstream dam on the Green River in Massachusetts and the only dam located in this segment (MA33-28). ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of installing fish passage at the water supply dam. Implementation of the recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The USGS operates a stream gaging station (01170100) within this segment. Data from this gage (period of record 1967 to present) revealed that the annual mean flow for 2000 (106 cfs) has been in excess of the annual mean flow recorded over the past 32 years (90.4 cfs) (Socolow, R. *et. al*. 2001). The seven-day, ten-year low flow estimate is 5 cfs (USGS 2003).

The Green River is stocked with Atlantic salmon fry, but no upstream fish passage is currently available at the Greenfield water supply dam. The dam, used by Greenfield for water supply purposes, is a new, approximately 14 feet high, concrete dam in good condition. Results of a US Army Corps of Engineers Green River Stream Ecosystem Restoration Feasibility Study to examine fish passage options are not yet available.

Biology

MA DFWELE conducted fish sampling in two reaches of this segment of the Green River in August 2000. Only three individuals of three different species of fish (slimy sculpin (*Cottus cognatus*), brown trout (*Salmo trutta*), and a longnose dace *(Rhinichthys cataractae*)) were captured in the reach sampled just south of the Vermont border. Only longnose and blacknose dace (*Rhinichthys atratulus)* (n=12) were captured in the reach of the Green River south of the confluence with Hibbard Brook in Leyden. Although all fish collected were fluvial dependants/specialists and at one location all were intolerant or moderately tolerant of pollution, the low number of fish are notable and worthy of further investigation. Richards (2003) attributes the low number of fish collected to poor sampling efficiency.

Chemistry-water

Water quality sampling was conducted by DWM in this segment of the Green River at the USGS gaging station just north of East Colrain (Station GR07). This site was sampled in July, August, and October 2000 (n = 3) (Appendix A, Tables A8 and A9). This station and Station GR08, located about 0.3 miles downstream from the confluence with Browning Brook, were also sampled by DWM in August 1995 (Appendix G, Tables G3 and G4).

DO and % saturation

DO levels in the Green River measured by DWM in 2000 were not less than 9.4 mg/L (Appendix A, Table A8). Percent saturation ranged from 91 to a high of 98%. It should be noted that these data represent worst-case (pre-dawn) conditions.

Temperature

The maximum temperature in the Green River measured by DWM in 2000 was 16°C (Appendix A, Table A8).

pH and Alkalinity
The pH of the Green River ranged between 7.3 and 7.7 SU (Appendix A, Table A8).
Alkalinity in the Green River ranged from 31 to 38 mg/L (qualified data omitted) (Appendix A, Table A9.

Suspended Solids
Suspended solids were below detection during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were measured in the Green River during the 2000 DWM surveys (Appendix A, Table A9).

Hardness
Hardness measurements of the Green River ranged from 36 to 44 mg/L (Appendix A, Table A9).

Phosphorus
No detectable concentrations of total phosphorus were measured in the Green River (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the limited water quality data. The low number of fish may be associated with poor sampling efficiency so further investigation is warranted.

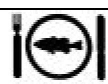
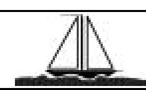
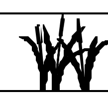
PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected one fecal coliform bacteria sample in this segment of the Green River from both the USGS gaging station just north of East Colrain (Station GR07) and about 0.3 miles downstream from the confluence with Browning Brook (Station GR08) in August 1995, however, these data were censored (Appendix G, Table G4).

No objectionable deposits or turbidity have been observed (Duerring 2003). Because this segment of the Green River is so rural and easily accessible via Green River Road some areas have been used perennially for illegal dumping of household and construction waste (see description of this area under ***Landfills*** above).

The Primary and Secondary Contact *Recreational* uses are not assessed for this segment of the Green River. The *Aesthetics Use* is assessed as support but is identified with an Alert Status because of illegal dumping.

Green River (MA33-28) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	SUPPORT*

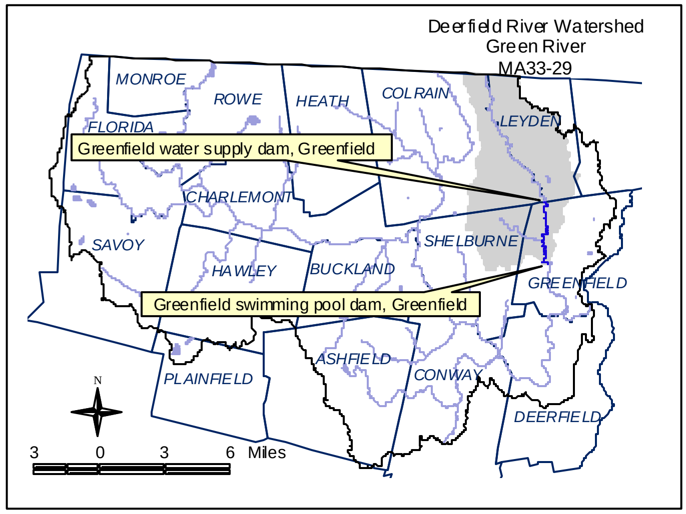
* "Alert Status" issues identified, see details in the use assessment section

RECOMMENDATIONS GREEN RIVER (MA33-28)

- Conduct water quality and biological monitoring in this segment of the Green River to more completely assess designated uses. In particular, fish population sampling should accompany the macroinvertebrate sampling effort. Due to the wide nature of this segment reach fish sampling should employ multiple crews or a barge-mounted electrofishing unit.
- Investigate possible impacts to aquatic life from potential nonpoint sources of pollution, including the large auto junkyard along the Green River in Guilford VT.
- Support the recommendations of the ACOE Green River Feasibility Study and assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.

- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- Continue to address the trash dumping problem on Green River Road.
- The Towns of Leyden and Colrain should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the towns can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Green River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Leyden and Colrain should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the South River subwatershed identified and mapped patchy to dense distribution of this plant growing along the riverbanks. Upstream of West Leyden knotweed was found in small patches. In the lower portion of this segment (below Workman Brook confluence) the knotweed patches increased in both number and density. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

GREEN RIVER (SEGMENT MA33-29)
Location: From the Greenfield water supply dam (north of Eunice Williams Road), Greenfield, to the Greenfield swimming pool dam (northwest of Nash's Mill Road), Greenfield (formerly part of Segment MA33-09).
Segment Length: 4.6 miles.
Classification: Class B, Cold Water Fishery.



The drainage area of this segment is approximately 33.8 square miles.
Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	71.4%
Agriculture	14.4%
Open Land	6.9%

This segment of the Green River (MA33-29) has a significantly different topology from the upstream segment (MA33-28). As the Green River leaves the Greenfield water supply at the northern border of the Town of Greenfield the gradient lessens and the flood plain widens. The channel also narrows and deepens because of the softer sedimentary bedrock and highly erodible unconsolidated deposits in that area. The river meanders through an area of open fields and agriculture and receives the flow from Glen Brook about 1.5 miles from the top of this segment. The Green River continues on its sinuous course, receiving the flow from Hinsdale Brook, to an impoundment by Nash's Mill Road. The pond created here is known as the "Greenfield Municipal Pool". This dam marks the downstream edge of this segment.

MA DFWELE has recommended that the Glen and Allen brooks, tributaries to this segment of the Green River, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
						1998	1999	2000	2001
Greenfield Water Department	1114000		10311401	Glen Brook-Upper Reservoir-01S	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY
Based on the available information, there are no NPDES regulated surface wastewater discharges in this subwatershed.

OTHER
ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The Greenfield swimming pool dam marks the end of this segment and is the second most upstream dam on the Green River in Massachusetts. It is the only dam located in this segment (MA33-29). ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of installing fish passage at the swimming pool dam. Implementation of the recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

The Green River is stocked with Atlantic salmon fry by MA DFWELE, but no upstream fish passage is currently available at either the water supply dam (MA33-28) or the Greenfield swimming pool dam. Results of the ACOE Stream Ecosystem Restoration Feasibility Study on the Green River to examine fish passage and other ecosystem restoration options are not yet available (described above). The swimming pool dam is a 2 feet high concrete structure that is enhanced with flashboards during the swimming season to raise the pool behind the dam. These flashboards are removed during the non-swimming season.

The Green River was sampled by DWM downstream from Eunice Williams Drive in Greenfield (Station GR02) in September 2000. At the time of the survey the river was roughly 15 m wide with depths ranging from 0.2 to 0.4 m. The substrates were comprised primarily of cobble and pebble. The overall habitat score was 169 (Appendix B). Habitat quality was limited most by instream available cover and limitations related to velocity/depth combinations.

Biology

Compared to the Cold River reference station (Station CR01) the RBP III analysis indicated the benthic community was non-impacted in the Green River downstream from Eunice Williams Drive in Greenfield (Station GR02) in September 2000 (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the Green River in 1988 (Appendix C).

DWM biologists collected periphyton samples from Station GR02, located downstream from Eunice Williams Bridge, Greenfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 0% and percent algal cover was not reported. The dominant algal types were blue-greens. No nuisance algal growth was documented. (Appendix D)

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the benthic macroinvertebrate community information.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria sampling was conducted by the DRWA in the Green River downstream from the public water supply dam in an informal swimming area in Greenfield (Station GRR-030) between June and August 2001 and 2002 (n = 7 wet weather sampling events and 4 dry weather sampling events). Fecal coliform counts at this station ranged from 9 to 140 colonies/100 mL (DRWA 2001 and DRWA 2002).

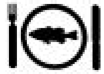
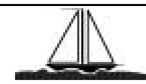
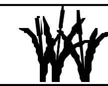
> Note: ESS conducted some fecal coliform bacteria sampling in one tributary to this segment of the Green River. The fecal coliform bacteria counts in Allen Brook (Station DW17) at Plain Road bridge in Greenfield ranged from <10 to 3260 col/100 mL, with two of six counts greater than 200 cfu/100 mL. The two counts were both representative of wet weather conditions, but only one of the elevated counts was collected during the *Primary Contact Recreational Season*.

In addition to the station monitored by DRWA the Town of Greenfield also operates a swimming area on the impounded portion of the Green River near Nash's Mill Road immediately upstream of the aforementioned swimming pool dam at the end of this segment. The Greenfield Board of Health has sampled this beach weekly and no closings/postings were reported in 2001 and 2002 (Shields 2003a and MA DPH 2002c).

No objectionable deposits, odors, turbidity, or other conditions were noted by DWM biologists (Appendix B).

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as support for this segment of the Green River based on the low fecal coliform bacteria counts and the habitat quality information.

Green River (MA33-29) Use Summary Table

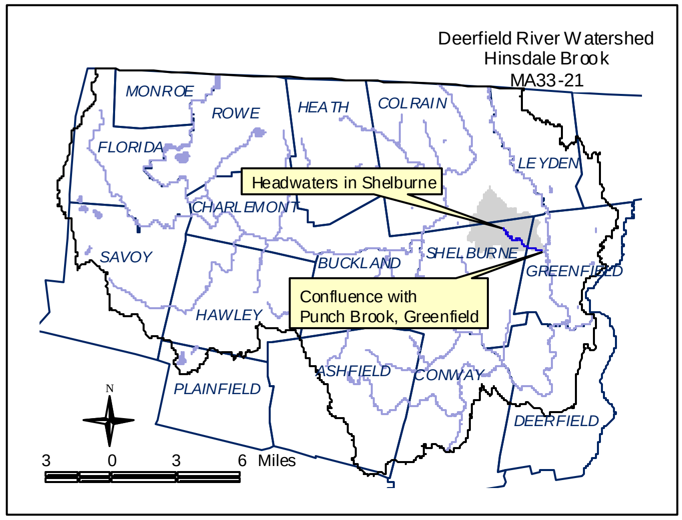
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT

RECOMMENDATIONS GREEN RIVER (MA33-29)

- Conduct water quality and biological monitoring in this segment of the Green River during the next monitoring year (2005) to continue to assess designated uses. In particular, biomonitoring is recommended here to continue to assess biological health. Fish population sampling should accompany the macroinvertebrate sampling effort. Due to the wide nature of the segment, fish sampling may require multiple crews or a barge-mounted electrofishing unit. Bacteria monitoring in this segment as well as the Allen Brook tributary is also recommended.
- Support the recommendations of the ACOE Green River Feasibility Study and assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.
- Glen and Allen Brooks, tributaries to this segment of the Green River, should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- The Town of Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan Greenfield can work cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Green River subwatershed, it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Greenfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their communities' character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Green River subwatershed identified and mapped patchy distribution of this plant growing along the riverbanks. The knotweed patches that were observed throughout this segment were found to be denser and more numerous than in the above segment. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).

HINSDALE BROOK (SEGMENT MA33-21)

Location: Headwaters, east of Fiske Mill Road, Shelburne, to confluence with Punch Brook, Greenfield.
Segment Length: 3.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 6.49 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	59.3%
Agriculture	19.5%
Open Land	13.4%

Hinsdale Brook begins near the border between Colrain and Shelburne. The stream flows southeast within a narrow valley along Greenfield Road and receives the flow from Stewart Brook. After passing into Greenfield it joins with Punch Brook about 0.1 miles above the confluence of Punch Brook and the Green River.

MA DFWELE has recommended that Hinsdale Brook be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY

Based on the available information there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

USE ASSESSMENT

AQUATIC LIFE

<u>Habitat and Flow</u>

Hinsdale Brook was sampled by DWM biologists in September 1996 downstream from Greenfield Road in Shelburne (Station VP05HIN) as part of the MA DEP Biocriteria Development Project (MA DEP 1996b). At the time of the survey the brook was roughly 2.5 m wide with depths ranging from 0.25 to 0.5 m. The substrates were comprised primarily of cobble and boulder/gravel. The overall habitat score was 117 (MA DEP 1996b). The instream habitat was limited most by poor bank stability on the right bank, lack of bank vegetative protection, sediment deposition and channel alteration as well as the channel flow status.

<u>Biology</u>

Hinsdale Brook was sampled by DWM biologists downstream from Greenfield Road in Shelburne (Station VP05HIN) as part of the MA DEP Biocriteria Development Project in September 1996 (MA DEP 1996b). Fish species captured, in order of abundance, included: Atlantic salmon *(Salmo salar*), slimy sculpin *(Cottus cognatus)*, blacknose dace *(Rhinicthys atratulus)*, brook (*Salvelinus fontinalis)* and brown trout (*Salmo trutta)* and an individual each of longnose dace (*Rhinicthys cataractae)* and golden shiner (*Notemigonus crysoleucas)* (MA DEP 1996b). Multiple age classes of Atlantic salmon were present. All fish species collected in this brook are fluvial specialists/dependants with the exception of an individual golden shiner. The presence of multiple age classes of Atlantic salmon, dominance by intolerant species, and the general absence of macrohabitat generalists indicated good habitat and water quality conditions as well as stable flow regimes.

<u>Chemistry-water</u>

In-situ measurements (DO, %saturation, pH, temperature, conductivity, and turbidity) in Hinsdale Brook downstream from Greenfield Road in Shelburne (Station VP05HIN) were taken on 25 September 1996 (Appendix A, Table A8).

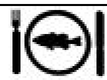
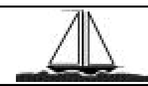
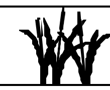
Although the fish community is indicative of good water quality conditions, because of the lack of additional water quality and biological data, the *Aquatic Life Use* is not assessed for Hinsdale Brook. This use is, however, identified with an Alert Status due to suboptimal habitat quality.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

No objectionable deposits, sheens, odors or other conditions were noted in Hinsdale Brook in the stream reach sampled by DWM biologists in September 1996 (MA DEP 1996b).

No recent data are available to assess the *Recreational* and *Aesthetic* uses, therefore, they are not assessed.

Hinsdale Brook (MA33-21) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED

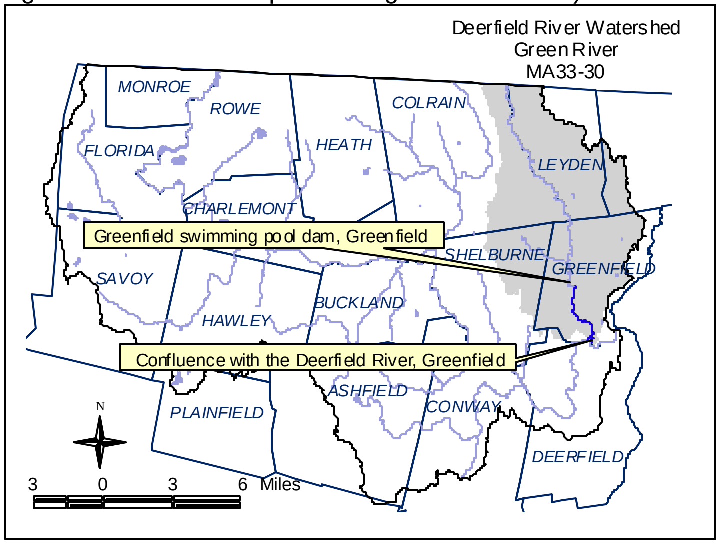
*Alert Status issues identified, see details in the use assessment

RECOMMENDATIONS HINSDALE BROOK (MA33-21)

- Conduct water quality and biological monitoring in this segment during the next monitoring year (2005) to assess designated uses.
- Hinsdale Brook should be protected as cold water fishery habitat as recommended by MA DFWELE.
- The Towns of Shelburne, Colrain, and Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the communities can work cooperatively with other watershed towns to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Hinsdale Brook subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Shelburne, Colrain, and Greenfield should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.

GREEN RIVER (SEGMENT MA33-30)

Location: From Greenfield swimming pool dam (northwest of Nash's Mill Road), Greenfield, to confluence with the Deerfield River, Greenfield (formerly Segment MA33-10 and part of Segment MA33-09).
Segment Length: 3.7 miles.
Classification: Class B, Cold Water Fishery.



The drainage area of this segment is approximately 52.1 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	65.2%
Agriculture	13.2%
Residential	10.7%

This segment of the Green River (one of three) begins as the outflow from the "Greenfield Municipal Pool". The river crosses under Route 91 and parallels this road for about 0.6 miles. The Green River then flows generally southeast, along the southern edge of the urbanized area of Greenfield. It finally flows into the Deerfield River just upstream from the outfall of the Greenfield Water Pollution Control Facility.

MA DFWELE has recommended that Mill Brook, a tributary in this subwatershed, be protected as cold water fishery habitat (MassWildlife 2001).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
					1998	1999	2000	2001
Bernardston Fire & Water District	1029000	10302901	Dug Well-01G Gravel Dug Well #2-02G	0.17	0.28	0.28	0.18**	0.06
Greenfield Water Department*	1114000	10311401	Millbrook Well #1-04 Millbrook Well #2-05 Millbrook Well #3-06	2.12	2.19**	2.23	2.07	2.18**

*not all sources necessarily within this segment, **withdrawal did not exceed registration amount by more than 0.1MGD (WMA threshold)

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H2)

The Greenfield WPCF discharge was moved from the Green River to the mainstem Deerfield River on 6 October 1999. There are no other permitted NPDES discharges to this segment of the Green River.

OTHER

ACOE Stream Ecosystem Restoration Feasibility Study

In 2000 the US Army Corps of Engineers began an Ecosystem Restoration Feasibility Study of the Green River with matching funds provided by the Executive Office of Environmental Affairs and the Town of Greenfield. The study is investigating the hydrologic, environmental, physical, cultural, and economic impacts of dam removal and/or installation of fish passage structures on four dams along the Green River, as well as other potential stream ecosystem restoration activities. The project is due to be completed in 2004. The first two dams located on the Green River lie in this segment. The upstream dam is known as the Mill Street Dam and the most downstream dam is called the Wiley Russell Dam. ACOE's report will likely provide specific recommendations and a cost/feasibility analysis of dam removal and/ or installation of fish passage structures at these dams. The report will also assess the feasibility of potential restorative actions along the riparian corridor such as erosion control and instream habitat restoration to improve habitat quality and reduce instream turbidity. Implementation of the recommendations is optional, but Greenfield may request funding from ACOE for up to 65% of the cost if they decide to follow them (ACOE 2001).

USE ASSESSMENT
AQUATIC LIFE

Habitat and Flow

The Green River is stocked with Atlantic salmon fry, but no upstream fish passage is currently available at the two dams in this segment - the Mill Street Dam and the Wiley and Russell Dam. Mill Street Dam is a concrete dam about 12 feet high and was originally owned and used by Greenfield Electric Light and Power. The dam was recently reconstructed and is in good condition. The Wiley and Russell Dam is a timber crib and concrete dam about 14 feet high and 165 feet in length with a storage capacity of 10 acre feet. The dam was originally built for water supply purposes for a tap and die factory adjacent to the site (factory demolished in 2002). The dam has two inoperable low-level outlets and has fallen into disrepair. A 1998 MA DEM Dam Safety Inspection Report classifies this dam as Significant Hazard (Class II) potential. Section 10.06(3) of MA DEM Dam Safety Regulations (310 CMR 10.00) defines Significant Hazard as: *"Dams located where failure or miss-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities."*

The Green River was sampled by DWM downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield (Station GR01) in September 2000. At the time of the survey the river was roughly 16 m wide with depths ranging from 0.1 to 0.8 m. The substrates were comprised primarily of cobble and sand/gravel. The overall habitat score was 135 (Appendix B). Habitat quality was limited most by bank stability, riparian vegetated zone width, embeddedness and channel flow status. Some areas of severe erosion were observed along the steeper portions of both banks (Appendix B).

Biology

Compared to the Cold River reference station (Station CR01) the RBP III analysis conducted by DWM in September 2000 indicated the benthic community was non-impacted in the Green River downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield (Station GR01) (Appendix B). Macroinvertebrate biomonitoring was also conducted at this station in the Green River in 1988 and 1995 (Appendix C). The most recent biological assessment of the benthic community in this portion of the Green River strongly suggests that water quality has improved.

DWM biologists collected periphyton samples from Station GR01, located downstream from the footbridge off Route 5-10 (at the end of Petty Plain Road) in Greenfield, at the same time as the September 2000 macroinvertebrate/habitat survey. Canopy cover was reported as 50% and percent algal cover was reported as 1%. The dominant algal types were blue-greens. No nuisance algal growth was documented. (Appendix D)

Chemistry – water

DWM collected water quality samples from two stations in this segment of the Green River; downstream from the Mill Street Dam in Greenfield (Station GR03) and just upstream from the confluence with the Deerfield River in Greenfield (Station GR02). These locations were sampled in July, August and October 2000 (n = 3) as part of the 2000 Deerfield River Watershed monitoring survey (Appendix A, Tables A8 and A9). Sampling was also conducted by DWM near the mouth of one tributary (locally known as Maple Brook – Station MB01). DWM also collected water quality samples from the Green River at the footbridge off Route 5-10 in Greenfield (at the end of Petty Plain Road) (Station GR) between June 1995 and June 1996 (n = 13) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were collected from the Green River at the footbridge off Route 5-10 (at the end of Petty Plain Road) (Station DW14) on as many as six occasions between August and November 2000 by ESS (ESS 2002). It should be noted that ESS also conducted some water quality sampling in four tributaries (Cherry Rum, Arms, Maple, and Wheeler brooks – see text box below) to this segment of the Green River.

DO and % saturation

DO measurements in the Green River measured by DWM and ESS in 2000 were not less than 8.2 mg/L and were as high as 11.0 mg/L (Appendix A, Table A8 and ESS 2002). Percent saturation ranged from 75.0 to a high of 103.2%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature
The maximum temperature in the Green River measured by DWM and ESS in 2000 was 20°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity
The pH of the Green River ranged between 7.1 and 7.5 SU (Appendix A, Table A8 and ESS 2002) Alkalinity of the Green River ranged from 41 to 46 mg/L (Appendix A, Table A9).

Suspended Solids
Suspended solids ranged from 1.6 to 4.4 mg/L during the 2000 surveys (Appendix A, Table A9).

Ammonia-Nitrogen
No detectable concentrations of ammonia-nitrogen were documented in the Green River during the 2000 DWM surveys (Appendix A, Table A9) (qualified data omitted).

Hardness
Hardness measurements of the Green River ranged from 49 to 53mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the Green River ranged from 0.011 to 0.02 mg/L (Appendix A, Table A9).

The *Aquatic Life Use* for this segment of the Green River is assessed as support based on the benthic macroinvertebrate community information and the water quality data. Habitat quality conditions related to poor bank stability, limited riparian zone width and substrate embeddedness are of concern and, therefore, this use is identified with an Alert Status.

PRIMARY CONTACT AND SECONDARY CONTACT RECREATION AND AESTHETICS

Note: ESS conducted fecal coliform bacteria sampling in four tributaries (Cherry Rum, Arms, Maple, and Wheeler brooks) to this segment of the Green River that were upstream from their sampling location on the mainstem Green River (Station DW14) (ESS 2002). Results are summarized below.

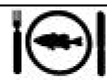
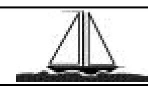
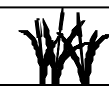
- Cherry Rum Brook (Station DW18) was located near the confluence with Green River, Greenfield. Fecal coliform bacteria counts ranged from 40 to 500 cfu/100 mL with one of six counts greater than 400 cfu/100 mL. The high count was collected during the *Primary Contact Recreational Season* and representative of wet weather conditions. In the fall of 2002 a Greenfield Community College (GCC) student conducted an optical brightener study of Cherry Rum Brook. All optical brightener samples collected at three sites during a two-month period along the length of the brook were negative, indicating that sewage contamination is likely not the source of elevated bacteria counts in this brook (Metcalfe 2002).
- Arms Brook was sampled at Station DW22 and Station DW15. Station DW22 was located upstream from sampling Station DW15, along a private dirt drive, Greenfield. Station DW15 was located at Colrain Road bridge, Greenfield. Fecal coliform bacteria counts were 110 and 290 cfu/100 mL at Station DW22 and ranged from 270 to 5,790 cfu/100 mL at Station DW15. In 2001 another GCC student conducted an optical brightener study on Arms Brook (Lively 2001). Sampling at six sites along the length of the brook occurred during November and December and no optical brighteners were detected in any of the samples. Fecal coliform samples were collected at these sites by the student and analyzed by the Greenfield WWTP on two occasions. Counts ranged from 26 cfu/100 mL at the upstream station to TNTC (too numerous to count) at the downstream station. Cows were observed in and around this brook during the study, so consequently the study concluded that the source of the high bacteria counts to this brook were the cows. After the study in 2002 the cows were sold and the field is no longer being used for grazing.
- Maple Brook Station DW13 was located at the confluence with the Green River, Greenfield. Fecal coliform bacteria counts ranged from 1,700 to 2,250 cfu/100 mL and four of six counts were reported as >2,000 cfu/100 mL. In 1998, an optical brightener study was conducted on Maple Brook by a University of Massachusetts graduate student (Skalka 1999). Results collected over a three-month period (September – November) showed that eight of the 16 sites sampled in Maple Brook tested positive for optical brighteners. Maple Brook is culverted for most of its length through Greenfield. The Greenfield DPW is aware of the areas where contamination is occurring (likely from leaking sewer pipes) and is currently correcting the problem (Shields, 2003b).
- Wheeler Brook Station DW16 was located at Woodard Road bridge, Greenfield. Fecal coliform bacteria counts ranged from 10 to 1,700 cfu/100 mL with two of six counts greater than 200 cfu/100 mL. Both high counts were representative of wet weather conditions.

On the Green River fecal coliform bacteria samples were collected at the footbridge off Route 5-10 (at the end of Petty Plain Road) (Station DW14) on six occasions, representing both wet and dry weather sampling, between August and November 2000 by ESS (ESS 2002). Fecal coliform bacteria counts ranged from 80 to 6,870 cfu/100 mL. Two of the six counts were greater than 400 cfu/100 mL and occurred during wet weather conditions. The geometric mean of all six samples is 319. The geometric mean of the bacteria samples collected during the *Primary Contact Recreational Season* is 188, with only one of four samples exceeding 400 cfu/100 mL (1800 cfu/100 mL).

This segment of the Green River flows through the urbanized portion of Greenfield. There are isolated areas of trash and debris along the riverbank. Turbidity and trash were also observed in the sampling reach during the biosurvey and a petroleum odor from the sediment was noted. No other objectionable conditions (e.g., water odors, oils, deposits) were recorded by DWM biologists (Appendix B).

The *Primary and Secondary Contact Recreational* uses are assessed as support for this segment of the Green River. However, they are both identified with an "Alert Status" because of elevated fecal coliform bacteria counts associated with wet weather events. There are also several tributaries to this segment of the Green River that exhibited elevated fecal coliform bacteria counts during both dry and wet weather. The *Aesthetic Use* is assessed as support but it is also identified with an "Alert Status" because of instream turbidity, and isolated areas of trash and debris.

Green River (MA33-30) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT*	SUPPORT*	SUPPORT*

* "Alert Status" issues identified, see details in the use assessment section

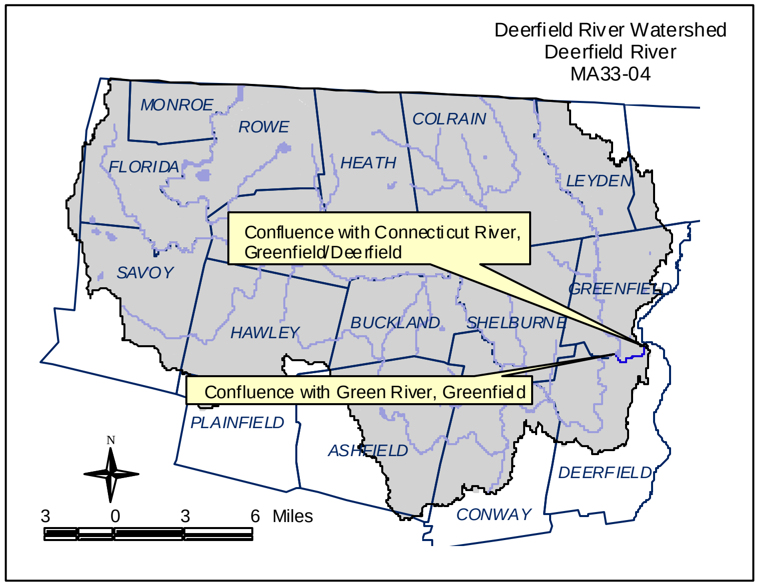
RECOMMENDATIONS GREEN RIVER (MA33-30)

- Continue to conduct water quality and biological monitoring in this segment to assess the designated uses. In particular, biomonitoring is recommended here during the next MA DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this low-gradient portion of the Green River, where both upstream agricultural activities and the urbanized nature of Greenfield potentially influence water quality and biological integrity. Fish population sampling, which has not historically been performed by MA DEP in the Green River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR01 sampling reach the fish population survey may require multiple crews or a barge-mounted electrofishing unit.
- Conduct frequent bacteria sampling in this segment of the Green River particularly during the *Primary Contact Recreational Season* to document current conditions and evaluate the effectiveness of any source reduction activities. For example, conduct fecal coliform sampling in Arms Brook to confirm that bacteria contamination is no longer occurring since cows were removed. If agricultural uses resume along this tributary and these uses contribute to elevated bacteria levels work with NRCS to encourage landowners to implement appropriate agricultural BMPs to protect the water quality.
- Support efforts by the Town of Greenfield in correcting leaking sewer lines (the likely source of bacteria contamination in Maple Brook) and implementing a proactive stormwater management plan.
- Support the recommendations of the ACOE Green River Feasibility Study. Assist the Town of Greenfield and others in securing funding to implement the recommendations of the study.
- Mill Brook, a tributary in this subwatershed should be protected as cold water fishery habitat as recommended by MA DFWELE.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by Greenfield Community College, DRWA and CRWC.
- The Town of Greenfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the town can work

cooperatively with other watershed communities to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.

- In order to prevent degradation of water quality in the Green River subwatershed it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. Greenfield should support recommendations of their recently developed individual municipal open space plan and/or Community Development Plan to protect important open space and maintain their communities' character.
- The rural roads that cross over and/or are in close proximity to watercourses should be identified. Field reconnaissance should be performed to evaluate their potential for impacting the water and habitat quality of these adjacent watercourses. Implementation of best management practices, as described in Unpaved Roads BMP Manual (BRPC 2001), should then be encouraged, as appropriate.
- The volunteer monitoring surveys to locate and map Japanese knotweed infestations conducted in 2003 by the DRWA as part of a Massachusetts Watershed Initiative/Deerfield River Watershed Team workplan project in the Green River subwatershed identified and mapped significant stands of this plant growing along the riverbanks from the Route 2A bridge in Greenfield to the confluence with the Deerfield mainstem. The knotweed stands in this segment were found to be larger and more contiguous than in the above segments. Results of this study should be consulted and local efforts to help manage current and future infestations of this invasive plant should be encouraged (Serrentino 2003).
- Support formation of a stream team to identify and stencil stormdrains that flow into the Green River from the urbanized areas of the Town of Greenfield.

DEERFIELD RIVER (SEGMENT MA33-04)
Location: Confluence with Green River, Greenfield, to confluence with Connecticut River, Greenfield/Deerfield.
Segment Length: 2.0 miles.
Classification: Class B, Warm Water Fishery.



The drainage area of this segment (in Massachusetts) is approximately 346.61 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	80.4%
Agriculture	8.9%
Residential	4.6

From the confluence with the Green River in Greenfield the Deerfield River meanders in a generally northeasterly direction. As it passes under Route 5 the river valley narrows as the river cuts its way through basalt bedrock. The river then passes under a railroad bridge and turns north entering the Connecticut River approximately a mile further downstream.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX H, TABLE H4)

Facility	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)			
				1998	1999	2000	2001
Trew Corporation	10307404	Trew Corp Well	0.14	0.15	0.02	0.01	0.01

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLES H1 AND H2)
As of November 1999 the Town of Greenfield is authorized to discharge from the Greenfield Water Pollution Control Plant (WPCP) to the Deerfield River downstream from the confluence with the Green River in Greenfield (NPDES permit MA0101214 issued October 2002). The permittee is authorized to discharge 3.2 MGD of treated sanitary wastewater via outfall 001. The facility's acute whole effluent toxicity limits are $LC_{50} \geq 100\%$ with a monitoring frequency of four times per year. The facility utilizes chlorine for disinfection (the maximum daily TRC shall not exceed 0.79 mg/L between 1 April and 31 October). The maximum TRC measurement recorded in the TOXTD database for this facility is 0.18 mg/L.

WTE Recycling is permitted (MAR05B674) to discharge stormwater from its facility on Southern Avenue, Greenfield to the Deerfield River.

OTHER
East Deerfield Railyard

The East Deerfield Railyard is approximately 129 acres and is located in a commercial/residential section of East Deerfield Massachusetts. The site, currently owned by Boston and Maine Railroad Corporation (B&M), has been an active railyard since the late 1800s. It is bounded to the north and east by open land and the Connecticut River, to the south by East Deerfield Road, and to the west by the Deerfield River. The site was classified as a Tier II Site on May 31, 2000 by MA DEP due to several incidences of oil and hazardous materials releases that have occurred at the railyard. Specific assessment and remedial activities were required under M.G.L. Chapter 21E for these releases. Although the Deerfield Watershed receives drainage from a relatively small part of the site, the railyard is very close to the Deerfield River (<200 m) and potential stormwater runoff and groundwater inputs are not known. The majority of the site lies within the Connecticut River Watershed.

USE ASSESSMENT
AQUATIC LIFE

Toxicity

Ambient

Water from the Deerfield River was collected approximately 50 feet upstream from the Greenfield WPCP discharge (or if the river is frozen upstream from the discharge Deerfield River water is collected near the Stillwater Bridge) in Deerfield for use as dilution water in the facility's whole effluent toxicity tests. Survival of *P. promelas* exposed (48-hours) to the river water was not less than 95% in the 13 tests conducted between November 1999 and December 2002.

Effluent

A total of 13 definitive acute whole effluent toxicity tests were conducted on the Greenfield WPCP effluent using *P. promelas* between November 1999 and December 2002. The effluent was not acutely toxic ($LC_{50} \geq 100\%$) to *P. promelas* during this period.

Chemistry - water

Water from the Deerfield River was collected approximately 50 feet upstream from the Greenfield WPCP discharge (or if the river was frozen upstream from the discharge Deerfield River water was collected near the Stillwater Bridge) for use as dilution water for the facility's whole effluent toxicity tests as required by their NPDES permit on 13 occasions between November 1999 and December 2002. Data from these reports, maintained in the TOXTD database by DWM, were summarized below.

DWM collected water quality samples from the Deerfield River downstream from the Route 5/10 bridge (southern channel of river) in Deerfield (Station DR10) in July August and October 2000 (n=3) as part of the 2000 Deerfield River Watershed monitoring survey (Appendix A, Tables A8 and A9). Sampling was also conducted by DWM downstream from the Route 5/10 bridge (on the northern channel) (Station 5-10) between September 1995 and June 1996 (n = 10) as part of the 1995/1996 Deerfield River Watershed monitoring survey (Appendix G, Tables G3 and G4).

Water quality samples were also collected from the Deerfield River at the Route 5/10 bridge (downstream side over the north channel), Greenfield (Station DW1) on as many as six occasions between August and November 2000 by ESS (ESS 2002).

The DRWA performs volunteer water quality monitoring in this segment of the Deerfield River near the Route 5/10 bridge in Greenfield (DER-010). Samples were collected for pH, DO, alkalinity, and temperature once during April in 2001 and 2002. However, due to the limited number of samples the results were not used in this assessment (DRWA 2001 and DRWA 2002).

As part of the "1998-1999 Connecticut River Nutrient Loading" project, water quality samples were collected by DWM on a monthly basis from the Deerfield River at the downstream side of the Route 5/10 Bridge in Deerfield/Greenfield (Station CT04) from June 1998 through May 1999 (Dallaire 2000).

DO and % saturation

DO levels in the Deerfield River measured by DWM and ESS in 2000 were not less than 8.9 mg/L and were as high as 11 mg/L (Appendix A, Tables A8 and ESS 2002). Percent saturation ranged from 88 to a high of 95%. It should be noted that these data represent both worst-case (pre-dawn) and daytime conditions.

Temperature

The maximum temperature in the Deerfield River measured by DWM and ESS in 2000 was 20.2°C (Appendix A, Table A8 and ESS 2002).

pH and Alkalinity

The pH of the Deerfield River ranged between 7.0 and 7.6 SU and alkalinity ranged from 10 to 60 mg/L upstream of the Greenfield WPCP discharge (TOXTD). Further downstream (at the Route 5/10 bridge) the pH of the Deerfield River ranged between 6.8 and 7.0 SU (Appendix A, Tables A8 -

qualified data excluded and ESS 2002). Alkalinity of the Deerfield River at the Route 5/10 bridge ranged from 11 to 17 mg/L during the summer of 2000 (Appendix A, Table A9).

Suspended Solids
The highest reported suspended solids concentration in the Deerfield River upstream of the Greenfield WPCP discharge was 28 mg/L, but, it should be noted that only one of the 13 measurements at this location was greater than 25 mg/L (TOXTD). Suspended solids in the river at the Route 5/10 bridge ranged from 1.4 to 5.7 mg/L during the 2000 surveys (Appendix A, Table A9) and from <1.0 to 36 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project. During this study two of the 13 measurements exceeded 25 mg/L (Dallaire 2000).

Ammonia-Nitrogen
The concentration of ammonia-nitrogen in the Deerfield River upstream from the Greenfield WPCP discharge ranged from 0.03 to 0.112 mg/L (TOXTD). No detectable concentrations of ammonia-nitrogen were documented in the Deerfield River at the Route 5/10 bridge during the 2000 DWM surveys (Appendix A, Table A9) and from <0.02 to 0.08 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project (Dallaire 2000).

Total Residual Chlorine
All of the 13 TRC measurements in the Deerfield River upstream from the Greenfield WPCP discharge were less than or equal to the minimum quantification level of 0.05 mg/L (TOXTD).

Hardness
Hardness measurements in the Deerfield River upstream of the Greenfield WPCP discharge ranged from 12 to 40 mg/L (TOXTD). Hardness measurements of the Deerfield River at the Route 5/10 bridge ranged from 17 to 23 mg/L (Appendix A, Table A9).

Phosphorus
Total phosphorus measurements in the Deerfield River near the Route 5/10 bridge ranged from 0.018 to 0.022 mg/L and from 0.02 to 0.11 mg/L during the "1998-1999 Connecticut River Nutrient Loading" project (Dallaire 2000). With the exception of the one high measurement of 0.11 mg/L none of the other 14 measurements taken during the nutrient loading study exceeded 0.06 mg/L. The high total phosphorus sample was the second sample collected on 28 July 1998 (12:48 hours). The DWM field survey crew noticed that after they had collected the first sample (at which time the Deerfield River was clear) the entire river below the bridge was turbid so they collected a second sample. The total phosphorus concentration was elevated when the river was turbid. Attempts to locate the source of the problem and the extent of the turbid conditions were not successful (Mattson 2003a). This survey was representative of dry weather conditions.

The *Aquatic Life Use* for this segment of the Deerfield River is assessed as support based on the good survival of test organisms exposed to the river water and the water quality data. This use, however, is identified with an Alert Status because of concerns reported to the Deerfield River Watershed Team from river users regarding flow regulation (hydromodification) resulting from the operations of the upstream hydroelectric generating facilities. Whether or not minimum flow requirements are being met and the effect, if any, of the hydropower generating developments on instream habitat and aquatic life is of concern and merits further investigation. The one episode of elevated total phosphorus and instream turbidity is also of concern.

FISH CONSUMPTION
In October 2000 fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in the lower Deerfield River (Maietta and Colonna-Romano 2001). Electrofishing in the Deerfield River between the confluence with the Green River and the mouth (Station F0113) resulted in the collection of three white suckers. These fish were composited and the edible fillet sample was analyzed for the presence of heavy metals, PCB and chlorinated pesticides. PCB was not detected nor was mercury in excess of the MA DPH action level of 0.5 ppm (Appendix B).

No site-specific advisory was issued for the Deerfield River by MA DPH based on their review of these data and so, the *Fish Consumption Use* is not assessed (precluded by the statewide Fish Consumption Advisory for mercury).

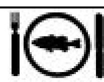
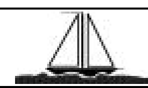
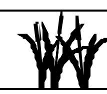
PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Fecal coliform bacteria samples were collected from the Deerfield River at the Route 5/10 bridge (downstream side over the north channel), Greenfield (Station DW1) on six occasions between August and November 2000 by ESS (ESS 2002). Four of the sampling dates were during the Primary Contact Recreational Season. No elevated fecal coliform counts were reported (range <10 to 80 cfu/100 mL) during this time. The highest count (340 cfu/100 mL) was collected in November and was representative of wet weather conditions. It was also collected during the season when the Greenfield WPCP discharge is not chlorinated. Fecal coliform bacteria sampling was also conducted by DWM in the Deerfield River at the Route 5/10 bridge in Greenfield/Deerfield (Station 5-10) between September 1995 and June 1996 (n = 9 sampling events) (Appendix G, Table G4).

While turbidity has often been observed in the Deerfield River during high spring flows and after rain events these conditions were considered to be a natural result of the soil types in the watershed. (Averill 2002). However, on at least one occasion a DWM field survey observed turbidity in the Deerfield River at the Route 5-10 Bridge while they were sampling. Instream turbidity was also documented by a DWM field survey crew in August 1998 (see discussion in *Aquatic Life Use*). The cause of the turbidity was not associated with wet weather conditions, but, attempts to locate the source of the problem and the extent of the turbid conditions were not successful (Mattson 2003a).

The *Primary Contact Recreational Use* is assessed as support based on the low fecal coliform bacteria counts during the primary contact season. The *Secondary Contact Recreational Use* is also assessed as support, although it should be noted that higher counts (not in excess of the water quality standards) do occur in this section of the river when the Greenfield WPCP is not chlorinating its discharge. The *Aesthetics Use* is also assessed as support based on the generally high aesthetic quality of the river. This use, however, is identified with an Alert Status because of concerns about observations of high turbidity that could not be explained.

Deerfield River (MA33-04) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
SUPPORT*	NOT ASSESSED	SUPPORT	SUPPORT	SUPPORT*

*Alert status issues identified, see details in use assessment section

RECOMMENDATIONS DEERFIELD RIVER (MA33-04)

- Continue DWM water quality and biological monitoring in this segment during the next monitoring year (2005). Investigate possible sources of occasional high turbidity.
- Evaluate biota, water and sediment quality impacts to the Deerfield River from the East Deerfield Railyard and WTE site.
- Encourage local stewardship/resource protection efforts by supporting the DRWA volunteer water quality monitoring program and annual river clean-ups by DRWA, CRWC, Zoar Outdoor and Trout Unlimited.
- The Towns of Greenfield and Deerfield should participate in the Deerfield River Watershed Regional Open Space Plan, which was funded by the Massachusetts Watershed Initiative/Deerfield River Watershed Team and conducted by the Franklin Regional Council of Governments. Through this plan the communities can work cooperatively with other watershed towns to prioritize regional open space and recreational land acquisitions and protection goals, including water resources.
- In order to prevent degradation of water quality in the Deerfield River it is recommended that land use planning techniques be applied to direct development, preserve sensitive areas, and maintain or reduce the levels of impervious cover. The Towns of Greenfield and Deerfield should support recommendations of their recently developed individual municipal open space plans and/or Community Development Plans to protect important open space and maintain their communities' rural character.

DEERFIELD RIVER WATERSHED - LAKE ASSESSMENTS

A total of 29 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) have been identified and assigned PALIS code numbers in the Deerfield River Watershed (Ackerman 1989 and MA DEP 2001a). However, three lakes from this PALIS list (Greenfield Reservoir in Leyden, Little Mohawk Pond in Shelburne, and Schneck Brook Pond in Conway) have not been included in this report because it has been determined that they no longer exist as lakes (dam removed and/or filled in with aquatic vegetation). Another lake (Paddy Hill Pond, Ashfield) on the Deerfield Watershed PALIS list was found to be located in the Westfield Watershed and two others (South River Impoundment in Conway and Lower Reservoir in Rowe/Florida) are being assessed as part of the river segments where they exist as run of the river impoundments so they are not included in the lakes assessment to avoid redundancy. As a result of these updates and omissions a total of 24 named ponds exist in the Deerfield Watershed. This report includes information on 22 Deerfield Watershed lakes that are in the WBS database (Figure 9). The remaining 2 lakes, Beaver Pond in Hawley and Browns Pond in Monroe (1.4 acres total) are unassessed and therefore are not currently included as segments in the WBS database.

The total surface area of these 24 Deerfield River Watershed lakes in Massachusetts is approximately 562 acres. They range in size from less than one acre to 108 acres; 2 lakes are greater than 100 acres (including VT portion of Sherman Reservoir), and 4 are greater than 50 acres.

The 22 lakes assessed in this report represent 560.6 of the 562 acres, or greater than 99% of the surface area in the Massachusetts portion of the Deerfield River Watershed (Figure 9). Baseline lake surveys were conducted on two of these lakes (TMDL sampling) in the summer of 2000 (Appendix F, Tables F2 and F3). Synoptic surveys were conducted by DWM at 13 of these lakes in 1995 (Appendix F, Table F1). Table 4 presents the use assessments for the individual lakes in the Deerfield River Watershed.

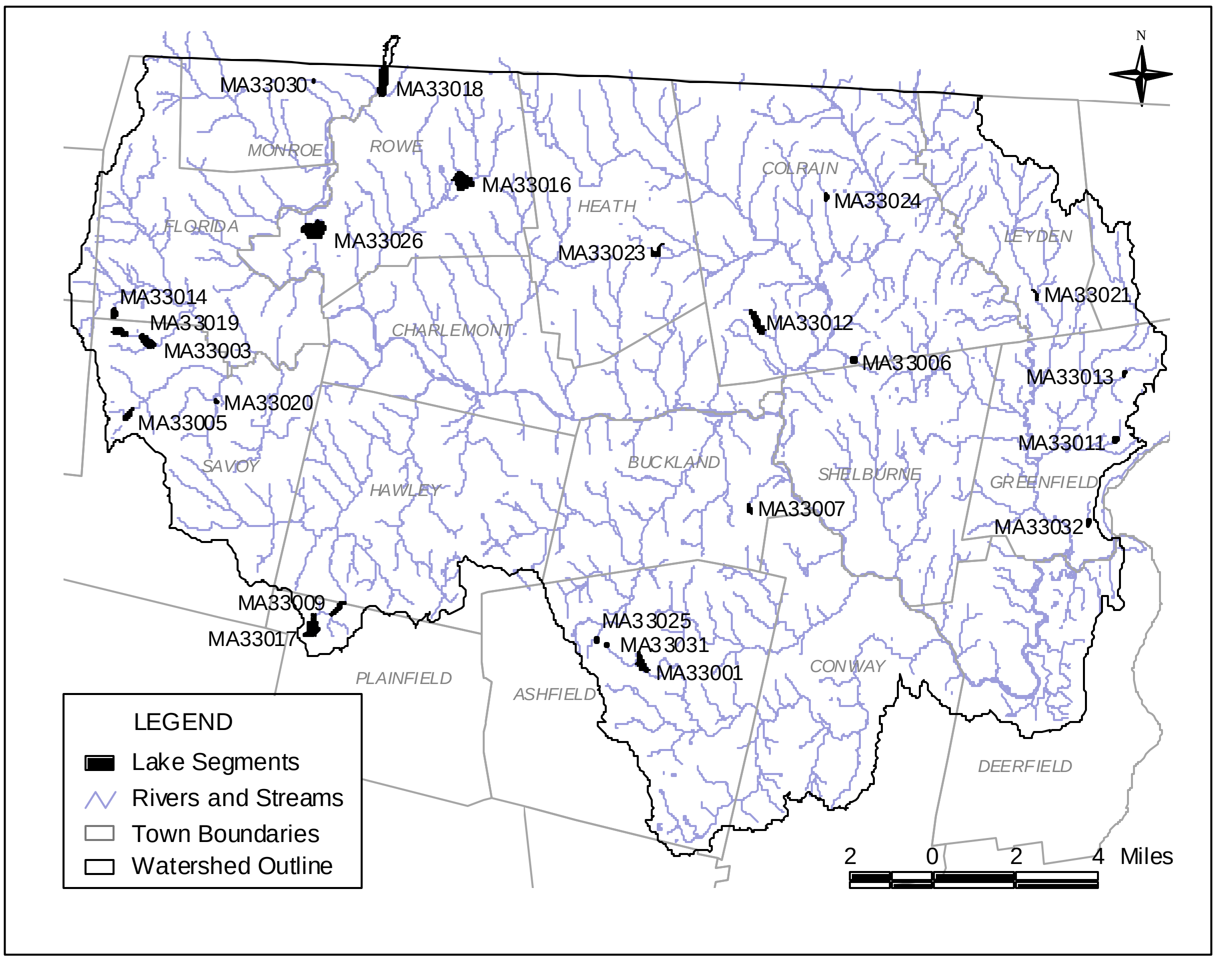


Figure 9. Deerfield River Watershed (Massachusetts Portion) – Lake Segment Locations Identified by WBID

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX H, TABLE H1)
The Yankee Atomic Electric Company (YAEC) in Rowe, an electric generating power plant, was authorized to discharge via three outfalls to Sherman Reservoir (NPDES permit MA0004367 issued in September 1988). The discharges were as follows:

- Outfall 001 - up to 225 MGD of condenser cooling water (maximum allowable temperature rise of 23.5°F over intake water temperature),
- Outfall 010 - 10.8 MGD of service water consisting of turbine lubricating oil, cooling water, generator hydrogen cooling water, and the primary plant effluent, and,
- Outfall 002 - 1.0 MGD of water treatment plant effluent, transformer cooling water, and floor drain water (maximum allowable rise of 35°F over intake water temperature).

The YAEC ceased operations on 26 February 1992. A new permit has been developed to authorize the discharge of up to 0.22 MGD of wastewater (spent fuel pool heat exchanger and dilution test tank effluent, stormwater, and excavation de-watering), resulting from the plant decommissioning process to Sherman Reservoir. The facility submitted two NPDES renewal applications to MA DEP and EPA for coverage for the discharge of plant decommissioning waters including stormwater and construction dewatering. The new NPDES permit was reissued in 2003 and will expire July 2008 (Hogan 2003).

Yankee Atomic Electric Company Decommissioning Activities:
Yankee Atomic Electric Company (YAEC) permanently shut down the Yankee Nuclear Power Station (YNPS) in Rowe, MA in February 1992 and has been actively decommissioning the facility since that time. During decommissioning there is a need to operate certain plant systems, requiring continued water use and discharge under the NPDES permit (see above). YNPS continues to use Sherman Reservoir as the source of water for the plant's cooling water system. Water is withdrawn from the reservoir through a 10-foot diameter pipe, located about 200 feet from shore at a depth of 70 feet. Historically, this non-contact cooling water was discharged via three outfalls. Decommissioning activities have resulted in the elimination of two of these outfalls and now only Outfall 001 discharges non-contact cooling water from the spent fuel pool heat exchanger and dilution for test tank effluent. Two independent stormwater outfalls discharge stormwater collected from the parking areas and buildings into Sherman Reservoir (Outfall 003) and the Deerfield River downstream of Sherman dam (Outfall 004). Raw material storage areas and decommissioning activities in areas that may affect the quality of stormwater are controlled through a Stormwater Pollution Prevention Plan.

Currently, YAEC is transferring spent fuel from the spent fuel pool (wet storage) to the independent spent fuel storage installation pad (dry storage) in preparation for the final dismantlement phase of the YNPS decommissioning. Once this phase is completed, the spent fuel pool must be drained before the building can be dismantled. YAEC has proposed to treat and drain the spent fuel pool water through NPDES Outfall 001. The spent fuel pool contains approximately 145,000 gallons of water. An additional 20,000 gallons will be used to rinse the spent fuel pool walls while draining, bringing the total discharge volume to 165,000 gallons. Prior to discharge of the pool, which contains a concentration of non-radioactive boron (estimated at 850 mg/l) and low level radioactivity, water will pass through a purification system to minimize the release of any radioactive materials to the environment. Purification will reduce the radiological activity to ensure compliance with the Nuclear Regulatory Commission (NRC) requirements of 10 CFR Part 50. The treated pool water will then be discharged via Outfall 001.

The flow rate through the system is estimated to be approximately 10 gpm and draining of the rinse water may occur in a series of batch releases over a period of several weeks. The entire draining process is expected to occur over a one-month period. The treated water will be monitored with an in-line, real-time radiation monitor prior to its release to Outfall 001. Grab samples will also be collected to monitor the purification system performance and provide an additional data point to confirm any radiation activity release determinations and dose projections resulting from discharge to Sherman Reservoir.

The dismantling of buildings and related structures, including foundation excavation, will likely result in areas that fill with either groundwater or stormwater. The water-filled excavations must be dewatered to complete the dismantling activity. Dewatering will be intermittent and only performed when needed. The discharge will be to Sherman Reservoir and controlled using best management practices recommended for construction dewatering activities and regulatory requirements.

LAKE USE ASSESSMENTS

Lake assessments are based on information gathered during DWM surveys (recent and historic) as well as pertinent information from other reliable sources (e.g., abutters, herbicide applicators, diagnostic/feasibility studies, MA DPH, etc.). The 1995 DWM synoptic surveys focused on visual observations of water quality and quantity (e.g., water level, sedimentation, etc.), the presence of native and non-native aquatic plants (both distribution and areal cover) and presence/severity of algal blooms (Appendix F, Table F1). During 2000 more intensive in-lake sampling was conducted by DWM in two lakes (Pelham Lake and Plainfield Pond) in the Deerfield River Watershed as part of the TMDL program. This sampling included: in-lake measurements of dissolved oxygen, pH, temperature, Secchi disk transparency, nutrients, and chlorophyll *a* (Appendix F, Tables F2 and F3). Sediment samples were collected by ESS in 2000 in Sherman Reservoir (ESS 2002). The *Primary Contact Recreational* Use was only assessed in two MA DCR (formerly MA DEM) owned lakes with public bathing beaches (North and South Ponds) where bacteria data were reported to MA DPH as part of the public beach monitoring program. To determine the status of the *Fish Consumption Use* fish consumption advisory information was obtained from the MA DPH (MA DPH 2002a). Although the *Drinking Water Use* was not assessed in this water quality assessment report, the Class A waters were identified. Information on drinking water source protection and finish water quality is available at http://www.mass.gov/dep/brp/dws/dwshome.htm and from the Deerfield River Watershed's public water suppliers.

The use assessments and supporting information were entered into the EPA Water Body System database. Data on the presence of non-native plants were entered into the MA DEP DWM informal non-native plant tracking database.

AQUATIC LIFE

Biology

No non-native aquatic macrophytes were observed in any of the 13 lakes surveyed by DWM in 1995 and/or 2000 (Appendix F, Table F1 and Mattson 2000). *Myriophyllum heterophyllum* (variable water milfoil) is the only non-native aquatic species suspected in the Deerfield River Watershed (Bog Pond). The mere presence of any non-native species is considered an imbalance to the native biotic community and so this lake is identified with an Alert Status. Additionally, this species has a high potential for spreading and can easily establish itself in downstream river segments in the Deerfield River Watershed.

Over a two-year period (2000-2002) the MA DFWELE conducted fish population sampling as part of the "Lakes Survey for TMDL Development" project (MA DFWELE 2002). This study included two lakes in the Deerfield River Watershed: Pelham Lake (Rowe - MA33016) and Plainfield Pond (Plainfield – MA33017).

Pelham Lake

Pelham Lake in Rowe was sampled by MA DFWELE for the above study using electrofishing, gillnetting and seining. The fish population was dominated by yellow perch (*Perca flavescens*). Other collected species included: pumpkinseed (*Lepomis gibbosus*), golden shiner (*Notemigonus crysoleucas*), chain pickerel (*Esox niger*), white sucker (*Catostomus commersoni*), largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus dolomieu*), and brown trout (*Salmo trutta*).

Plainfield Pond

Plainfield Pond in Plainfield was sampled by MA DFWELE for the above study using electrofishing, gillnetting and seining. The fish population was dominated by yellow perch (*Perca flavescens*). Other collected species included: chain pickerel (*Esox niger*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), largemouth bass (*Micropterus salmoides*), and golden shiner (*Notemigonus crysoleucas*).

Chemistry-water

Hypolimnetic oxygen depletion did not occur in either Pelham Lake or Plainfield Pond in September 2000 (Appendix F, Table F2). The total phosphorus concentrations were low to moderately high in Pelham Lake and were low in Plainfield Pond (Appendix F, Table F3). There are too little data (some data were censored) to assess the status of the *Aquatic Life Uses* for either of these ponds. Additional data/information needs to be researched to determine if these conditions are naturally occurring or anthropogenically induced.

Chemistry – sediment
Three sediment grab samples were collected and composited from behind Sherman Reservoir Dam on the Deerfield River (Station DWS-1) in July of 2000 by ESS (ESS 2002). The sediment sample was analyzed for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, PCB (polychlorinated biphenyls), PAH (polynuclear aromatic hydrocarbons), TPH (total petroleum hydrocarbons), TOC (total organic carbon), percent volatile solids, percent water, and grain size. With the exception of arsenic and copper all analytes fell below the low effects range (L-EL) as defined by Persaud et al. (1993). The arsenic concentration was measured at 25.5 ppm, which is approximately four times greater than the L-EL and the copper concentration was measured at 32.3 ppm, which is approximately two times greater than the L-EL. The sediment was comprised primarily of silt and clay (45.5%) and fine sand (27.5%) and the total volatile solids was 14.0% by weight. No PAH, TPH, or PCB were detected.

The *Aquatic Life Use* was not assessed in any of the lakes in the Deerfield River Watershed because of the cursory nature of the 1995 synoptic surveys and/or the lack of dissolved oxygen data and other more recent observations. *Aquatic Life Use* is identified with an Alert Status in Sherman Reservoir because the concentration of arsenic and copper in the sediment sample collected behind the Sherman Dam was slightly elevated. Bog Pond is also identified with an Alert Status since there is a report of a unconfirmed non-native species present there (*Myriophyllum heterophyllum*) (Table 4).

FISH CONSUMPTION
In July, 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination. The MA DPH "…is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)." Additionally, MA DPH "…is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)." MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. The advisory encompasses all freshwaters in Massachusetts and so, the *Fish Consumption Use* for lakes in the Deerfield River Watershed cannot be assessed as support.

Fish from two lakes in the Deerfield River Watershed were sampled in either 1995 or 2000 as part of the DWM watershed monitoring surveys. The lakes sampled were Sherman Reservoir (Rowe, MA / Monroe, MA / Whitingham, VT) and Bog Pond (Savoy). Fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in Sherman Reservoir in October 1995 and in Bog Pond in November 2000. These data can be found in Appendix E, Table E1 and Appendix B, *Appendix A, Table A5*. Fish were also sampled in 1994 by Rose et. al. (1999) in three Deerfield Watershed lakes (Ashfield Lake, Bog Pond and Plainfield Pond) as part of a study to investigate fish mercury distribution in Massachusetts.

Sherman Reservoir, Rowe, MA / Monroe, MA / Whitingham, VT (formerly included as part of river Segment MA 33-01)
Mercury in the fish tissue from Sherman Reservoir ranged from 0.204 to 0.785 mg/kg wet weight. The mercury data triggered a site-specific advisory against the consumption of fish from Sherman Reservoir. Selenium levels ranged from 0.138 to 0.327 mg/kg wet weight. PCB arochlors and congeners, pesticides, cadmium, arsenic, and lead were not detected in the edible fillets of all samples analyzed from Sherman Reservoir.

Bog Pond, Savoy
Mercury ranged from 0.14 mg/kg in a sample of brown bullhead (Bog00-04-06) to 0.38 mg/kg in yellow perch (Bog00-01-03). Due to the fact that predator fishes tend to be highest in mercury worst case conditions have not been assessed. Predatory fish from Bog Pond likely contain mercury in concentrations at or near the MA DPH 'trigger level' of 0.5 mg/kg. Cadmium, lead, and arsenic were below MDL (minimum detection limits) in all samples analyzed and selenium concentrations were consistent with those found in waterbodies throughout the Commonwealth. Selenium does not appear to be of concern.

Plainfield Pond, Plainfield
Mercury (average concentration of 0.182 mg/kg) was detected in tissue samples of brown bullhead, largemouth bass, and yellow perch in a study of mercury distribution in fish in Massachusetts lakes performed by Rose *et. al.* (1999). The mercury data triggered a site-specific advisory against the consumption of fish from Plainfield Pond.

Ashfield Lake, Ashfield
The study by Rose et. al. (1999) did not detect elevated concentrations of mercury (average concentration 0.083 mg/kg) in brown bullhead, largemouth bass and yellow perch sampled from Ashfield Lake.

The most recent MA DPH Fish Consumption List recommends the following for lakes in the Deerfield River Watershed (MA DPH 2002a):

Sherman Reservoir (Rowe/Monroe) because of elevated mercury,
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody,
2. the general public should not consume any yellow perch from this waterbody, and
3. the general public should limit consumption of non-affected fish from this waterbody to two meals per month."

Plainfield Pond (Plainfield) because of elevated mercury,
1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any Largemouth Bass from this waterbody, and
2. the general public should limit consumption of largemouth bass from this waterbody."

Sherman Reservoir (72 acres in MA out of a total of 162 acres representing both MA and VT acreage) and Plainfield Pond (60 acres) are assessed as impaired (due to mercury contamination) for the *Fish Consumption Use* (Table 4). The remaining 20 lakes, representing 430 acres, are not assessed for the *Fish Consumption Use*. [NOTE: The MA DPH fish consumption advisory list contains the status of each waterbody for which an advisory has been issued. If a waterbody is not on the list, it may be because either an advisory was not warranted or the water body has not been sampled. MA DPH's most current Fish Consumption Advisory list is available online at http://www.mass.gov/dph/beha/fishlist.htm. The source of mercury is unknown, although atmospheric deposition is suspected.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS
Bacteria samples were collected at two MA DEM (now known as MA DCR) beaches: North Pond in Florida and South Pond in Savoy in the Savoy State Forest. Elevated bacteria counts were documented infrequently in both of these ponds but neither were reported closed during the 2001 swimming season and were only closed or posted for short periods (2 days in North Pond and 1 day in South Pond) in the 2002 swimming season (Murphy 2002). Both the *Primary* and *Secondary Contact Recreational* uses are assessed as support for these two waterbodies.

There are three public beaches on lakes in the Deerfield River Watershed (Ashfield Pond in Ashfield, Pelham Lake in Rowe and Plainfield Pond in Plainfield). Although no beach closures/postings were recorded in the DPH beach closure database during the 2000/2001 seasons, too limited data are available and so, the Primary and Secondary Contact Recreational uses are not assessed.
The *Primary* and *Secondary Contact Recreational* uses are assessed as support in two lakes; North Pond and South Pond, representing a total of 48 acres. The *Aesthetics Use* for these waterbodies is not assessed. The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed in

the remaining 20 lakes (514 acres) in the Deerfield River Watershed because of a lack of bacteria, transparency and in-lake survey data.

SUMMARY

Only two of the 22 lakes (totaling 132 acres) in the Deerfield River Watershed listed in this report are impaired for the *Fish Consumption Use*. The cause of impairment is mercury contamination. Two other lakes, totaling 48 acres, supported the *Primary* and *Secondary Contact Recreational* uses. A total of 18 lakes (382 out of 562 acres) are not assessed for any uses. The Aquatic Life Use for Bog Pond was identified with an Alert Status because *Myriophyllum* sp. (a non-native aquatic macrophyte) is suspected. The Aquatic Life Use for Sherman Reservoir was also identified with an Alert Status because of slightly elevated concentrations of arsenic and copper in the sediments.

Table 4 presents the use assessments for the individual lakes in the deerfield river watershed.

RECOMMENDATIONS – LAKES

- Confirm the presence of *Myriophyllum heterophyllum*, which is suspected to occur in Bog Pond (Savoy).
- Coordinate with MA DCR and/or other groups conducting lake surveys to generate quality assured lakes data. Conduct more intensive lake surveys to better determine the lake trophic and use support status. As sources of impairment are identified within lake watersheds they should be eliminated or, at least, minimized through the application of appropriate non-point source control techniques.
- Continue to review data from “Beaches Bill” required water quality testing (bacteria sampling at all formal bathing beaches) to assess the status of the recreational uses.
- Quick action is necessary to manage non-native aquatic or wetland plant species that are isolated in one or a few location(s), in order to alleviate the need for costly and potentially fruitless efforts to do so in the future. Two courses of action should be pursued concurrently. More extensive surveys need to be conducted, particularly downstream from these recorded locations to determine the extent of the infestation. And, "spot" treatments (refer to the draft Generic Environmental Impact Report for Eutrophication and Aquatic Plant Management in Massachusetts [Mattson et *al*. 2004] for advantages and disadvantages of each) should be undertaken to control populations at these sites. These treatments include careful hand-pulling of individual plants in small areas. In larger areas other techniques, such as selective herbicide application, may be necessary. In either case, the treatments should be undertaken prior to fruit formation and with a minimum of fragmentation of the individual plants. These actions will minimize the spreading of the populations. This draft aquatic plant report should be consulted prior to the development of any lake management plan to control non-native aquatic or wetland plant species.
- Prevent spreading of invasive plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

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Table 4. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Ashfield Pond, Ashfield	MA33001	38	Not Assessed	Not Assessed	Not Assessed	Not assessed	Not assessed
Ashfield Pond has a public bathing beach and although no bathing beach closures were recorded during the 2001 /2002 seasons at the Ashfield public beach too limited data are available so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are not assessed. It should be noted that Ashfield Lakehouse, a private organization, also has a beach. Fish tissue from Ashfield Pond was analyzed for mercury as part of a study in 1994 by Rose *et. al.* (1999) to examine fish mercury distribution in Massachusetts lakes. Concentration of mercury in tissue did not exceed the MA DPH action level. No site specific advisory was issued and, so, the *Fish Consumption Use* is not assessed.							
Bog Pond, Savoy	MA33003	35	Not Assessed*	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Myriophyllum heterophyllum (variable water milfoil) may be present in Bog Pond, but, this needs confirmation. Because this non-native aquatic macrophyte may be present the *Aquatic Life Use* is identified with an Alert Status. Fish toxics monitoring for PCB, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Bog Pond as part of the Deerfield River Watershed survey in 2000. The concentrations of total mercury and PCB did not exceed MA DPH action levels of 0.5 and 1.0 mg/Kg, respectively, in the samples analyzed. No site specific advisory was issued and, so, the *Fish Consumption Use* is not assessed. However, all fish analyzed were small and top level predators were not collected, so, worst-case conditions for mercury were not evaluated. Fish tissue from Bog Pond was also analyzed for mercury as part of a study in 1994 by Rose *et. al.* (1999) to examine fish mercury distribution in Massachusetts lakes. Concentration of mercury in fish tissue did not exceed the MA DPH action level in this study.							
Burnett Pond, Savoy	MA33005	18	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Fox Brook Upper Reservoir, Colrain	MA33006	3	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Fox Brook Upper Reservoir is a Class A, Public Water Supply. Shelburne Falls Fire District is registered and permitted to withdraw water from Fox Brook Upper Reservoir (0.44 MGD). Additional information is provided in the Deerfield River Segment MA33-06 and Appendix H, Table H4.							
Goodnow Road Pond, Buckland	MA33007	11	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Hallockville Pond, Hawley/Plainfield	MA33009	19	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Highland Pond, Greenfield	MA33032	2	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Two MA DEM grants were awarded for this pond: In 1997 a management study was funded that was supposed to include water quality and sediment testing, an aquatic vegetation survey, species inventory and an assessment of watershed nutrient and sediment loading. In 1999 the second project was funded to control sedimentation and erosion by installing two sedimentation basins and an erosion control slope. Also included was water quality monitoring, development of an education brochure of the pond and developing a scope for dredging the pond.							
Lower Reservoir, Rowe	MA33028	107	Lower Reservoir is included as part of Deerfield River Segment MA33-01, where it exists as a run of the river impoundment, so it is not included in the lakes assessment (or acreage totals) to avoid redundancy.				
Maynard Pond, Greenfield	MA33011	3	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Table 4 Continued. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
McLeod Pond, Colrain	MA33012	41	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Mt. Brook Reservoir, Colrain	MA33024	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Mt. Brook Reservoir is a Class A, Water Supply.							
Newell Pond, Greenfield	MA33013	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
North Pond, Florida	MA33014	19	Not Assessed	Not Assessed	Support	Support	Not Assessed
North Pond is in the MA DEM Savoy State Forest in Florida. The pond has a public bathing beach. This beach was posted for two 2-day periods in June and July 2002 because of elevated bacteria and no postings were recorded for the 2001 swimming season. Because the beach was open for the all of the 2001 and the majority of the 2002 bathing seasons, the *Recreational* uses are assessed as support. The *Aesthetics Use* is not assessed.							
Papoose Lake, Heath	MA33023	14	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Pelham Lake, Rowe	MA33016	80	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
The fish population (MA DFWELE sampling in 2000) was dominated by yellow perch (*Perca flavescens*). Note: TMDL survey conducted in 2000 and synoptic survey in 1995 (Appendix F). This pond had adequate dissolved oxygen at all depths and pH was near neutral during a single September survey in 2000 (Appendix F). Alkalinity was low (<2-6 mg/l) during three surveys during the summer of 2000. Total phosphorus during the same period ranged between <0.009 to 0.043 mg/L in the surface waters. Biovolume density estimated as <10% dense/very dense cover and no non-native aquatic plants were identified (Appendix F). Since the data were limited the *Aquatic Life Use* is not assessed. The Secchi disk depths ranged from 1.3 to >3.0 m (meeting the bathing beach guidelines) even though the water was colored. Pelham Lake has a public bathing beach and, although no bathing beach closures were recorded during the 2001/2002 seasons at the public beach, too limited data are available, so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are not assessed. Pelham Lake is on the 1998 303(d) List of Waters because of noxious aquatic plants. However, after reevaluating past information and new data it was determined that the conditions in this lake were likely naturally occurring.							
Phelps Brook Reservoir, Monroe	MA33030	0.1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Phelps Brook Reservoir is a Class A, Public Water Supply.							
Plainfield Pond, Plainfield	MA33017	60	Not Assessed	Impaired (Mercury, 274)	Not Assessed	Not Assessed	Not Assessed
Because of elevated mercury (Rose *et. al*, 1999), MA DPH issued a fish consumption advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass from this waterbody and the general public should limit consumption of largemouth bass from this waterbody." Because of the site-specific advisory the *Fish Consumption Use* is assessed as impaired. The fish population (MA DFWELE sampling in 2000) was dominated by yellow perch (*Perca flavescens*). TMDL survey conducted in 2000 and synoptic survey in 1995 (Appendix F). This pond had adequate dissolved oxygen at all depths and pH was near neutral during a single September survey in 2000 (Appendix F). Alkalinity was low (<3 – 5 mg/l) during three surveys during the summer of 2000. Total phosphorus during the same period ranged between 0.007 to 0.014 mg/L (qualified data omitted). Biovolume density was estimated as 25% dense/very dense cover and no non-native aquatic plants were identified (Appendix F). Since the data were limited the *Aquatic Life Use* is not assessed. The Secchi disk was visible to the lake bottom (meeting the bathing beach guidelines) even though the water was colored. Plainfield Pond has							

Table 4 Continued. Deerfield Watershed Lake Use Assessment Summary

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Plainfield Pond continued: a town-run public bathing beach and although no bathing beach closures were recorded during the 2001/2002 seasons at the Plainfield Town Beach too limited data are available, so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are not assessed. Pelham Lake is on the 1998 303(d) List of Waters because of noxious aquatic plants. However, after reevaluating past information and new data it was determined that the conditions in this lake were likely naturally occurring.							
Sherman Reservoir, Rowe and Monroe, MA and Whitingham, VT	MA33018	72 (MA portion only)	Not Assessed*	Impaired (Mercury, 274)	Not Assessed	Not Assessed	Not Assessed
Note: Fish toxics monitoring for PCB, organochlorine pesticides and selected metals (including Hg, As, Se, Pb, and Cd) was conducted in Sherman Reservoir as part of the Deerfield River Watershed survey in 1995 (Appendix E, Table E1). Because of elevated mercury, MA DPH issued a fish consumption advisory recommending "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody and the general public should not consume any yellow perch from this waterbody. The general public should limit consumption of non-affected fish from this waterbody to two meals per month." Because of the site-specific advisory the *Fish Consumption Use* is assessed as impaired. Sediment samples collected behind the dam revealed slightly elevated concentrations of arsenic and copper, so the *Aquatic Life Use* is identified with an Alert Status. Note: Vermont also identifies this lake as impaired for the Fish Consumption Use (VT DEC 2003). Note: No public bathing beaches on the Rowe or Monroe portion of the Sherman Reservoir, but boat access on the Monroe portion. Note: Sherman Reservoir was formerly included as part of Segment MA33-01.							
South Pond, Savoy	MA33019	29	Not Assessed	Not Assessed	Support	Support	Not Assessed
South Pond is in the MA DEM Savoy State Forest in Savoy. The pond has a public bathing beach. Although elevated bacteria counts were documented in this pond during one week in July 2001 no beach postings were recorded in the MA DPH database. During July 2002, the beach was posted for a two 2-day period because of elevated bacteria. Because the beach was open for the majority of both the 2001 and 2002 bathing seasons the *Recreational* uses are assessed as support. The *Aesthetic Use* is not assessed.							
South River Impoundment, Conway	MA33022	2	South River Impoundment is included as part of Deerfield River Segment MA33-08, where it exists as a run of the river impoundment, so it is not included in the lakes assessment (or acreage totals) to avoid redundancy.				
Tannery Pond, Savoy	MA33020	1	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Upper Greenfield Reservoir Leyden	MA33021	6	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Also known as Glen Brook Upper Reservoir or Leyden/Glen Reservoir. Upper Greenfield Reservoir is a Class A, Public Water Supply. Greenfield Water Department is registered to withdraw water from Upper Greenfield Reservoir (2.12 MGD). Additional information is provided in the Green River Segment MA33-29 and Appendix H, Table H4.							
Upper Highland Springs Reservoir, Ashfield	MA33025	2	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Note: Upper Highland Springs Reservoir is a Class A, Public Water Supply.							
Upper Reservoir Bear Swamp, Rowe	MA33026	108	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

*"Alert Status" issues identified, see details in the use assessment section

LITERATURE CITED

Ackerman, M.T. 1989. *Compilation of Lakes, Ponds, Reservoirs and Impoundments Relative to the Massachusetts Lake Classification Program.* Publication: #15901-171-50-4-89-c.r. Technical Services Branch, Massachusetts Division of Water Pollution Control, Department of Environmental Quality Engineering, Westborough, MA.

ACOE. 2001. *Update Report for Massachusetts October 31, 2001.* US Army Corps of Engineers New England District, Concord, MA.

Averill, A. 2002. Personal communication regarding soil characteristics of the Deerfield Watershed. USDA, Natural Resources Conservation Service, Franklin County Field Office, Greenfield, MA.

Berkshire Regional Planning Commission (BRPC). 2001. *The Massachusetts Unpaved Roads BMP Manual*. Prepared for MA DEP and US EPA, Pittsfield, MA.

Breault, R.F. and S.L. Harris. 1997. *Geographical distribution and potential for adverse biological effects of selected trace elements* and *organic compounds in streambed sediment in the Connecticut, Housatonic, and Thames River Basins, 1992-94.* U.S. Geological Survey Water-Resources Investigations Report 97-4169. National Water-Quality Assessment Program, Water Resources Division, Marlborough, MA.

Chase, R. 2004. *Review Memorandum of External Data: Deerfield River Watershed 2/20/2004.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Coles, J.F. 1998. *Organochlorine compounds in fish tissue for the Connecticut, Housatonic, and Thames River Basins study unit, 1992-94.* U.S. Geological Survey. Water-Resources Investigations Report 98-4075. National Water-Quality Assessment Program, Water Resources Division, Marlborough, MA.

Dallaire, T. 2000. *Technical Memorandum. Re: 1998-1999 Connecticut River Nutrient Loading Project. CN#57.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

DRWA. 2001. *Deerfield River Volunteer Monitoring Program 2001 Final Report*. M.F. Walk, program leader, February 6, 2002. Deerfield River Watershed Association, Shelburne Falls, MA.

DRWA. 2002. *Deerfield River Volunteer Monitoring Program 2002 Final Report*. M.F. Walk, program leader, November 11, 2002. Deerfield River Watershed Association, Shelburne Falls, MA.

Duerring, C. 2003. Personal field observations on Green River recreational use and aesthetics. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Environmental Law Reporter. 1988. *Clean Water Deskbook*. Environmental Law Institute, Washington, D.C.

Environment Canada. 04 November 1999. *Canadian Environmental Quality Guidelines.* [Online]. Environment Canada. http://www.ec.gc.ca/ceqg-rcqe/tistbl_e.doc [28 September 1998].

EPA. 1997. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents.* U.S. Environmental Protection Agency, Assessment and Watershed Protection Division (4503F), Office of Wetlands, Oceans, and Watersheds, Office of Water, Washington D.C.

EPA. 1999a. *1999 Update of Ambient Water Quality Criteria for Ammonia.* U.S. Environmental Protection Agency, Office of Water and Office of Science and Technology, Washington, D.C. and Office of Research and Development, Duluth, MN.

EPA. 1999b. Federal Register Document. [Online]. United States Environmental Protection Agency. http://www.epa.gov/fedrgstr/EPA-WATER/1998/December/Day-10/w30272.htm.

EPA. 2002. *Consolidated Assessment and Listing Methodology – toward a compendium of best practices*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC.

Environmental Science Services, Inc. (ESS). 2002. *Water and Sediment Quality Assessment of the Deerfield River Watershed.* Prepared for Massachusetts Executive Office of Environmental Affairs, Deerfield Watershed Team. Wellesley, MA.

EOEA. 2000 – 2001. *Buildout Maps and Analyses*. [Online] http://commpres.env.state.ma.us/content/buildout.asp. Community Preservation Initiative, Boston, MA.

EOEA. 1999. *Fiscal Year 1999 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

EOEA. 2000. *Fiscal Year 2000 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

EOEA. 2001. *Fiscal Year 2001 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

EOEA. 2002. *Fiscal Year 2002 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

EOEA. 2003. *Fiscal Year 2003 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

EOEA. 2004. *Fiscal Year 2004 Deerfield River Watershed Annual Workplan.* Massachusetts Watershed Initiative. Executive Office of Environmental Affairs, Boston, MA.

Federal Energy Regulatory Commission (FERC). 1997. *New License for the Deerfield River Project L.P. No. 2323 and Amendment to the Bear Swamp License.* Office of Hydropower Licensing, Washington D.C.

Fiorentino, J. 1999. (John.Fiorentino@state.ma.us Worcester). *Deerfield benthos screening.* MA DEP DWM. E-mail to Christine Duerring (Deerfield River Watershed Team Leader) and David Slowick, John Bourcier (Department of Environmental Protection - Emergency Response, Western Regional Office) dated 26 August 1999.

Franklin County Planning Department. 1990. *Deerfield River Comprehensive Management Plan.* Lynn Rubenstein, ed., Greenfield, MA

Fuss and O'Neill, Inc. 2003. *Deerfield River Watershed Landfill Assessment*. Prepared for Massachusetts Executive Office of Environmental Affairs, Deerfield Watershed Team, West Springfield, MA.

Garabedian S.P., J.F. Coles, S.J. Grady, E.C.T. Trench and M.J. Zimmermen. 1998. *Water Quality in the Connecticut, Housatonic and Thames River Basins, Connecticut, Massachusetts, New Hampshire, New York and Vermont, 1992-95*. U.S. Geological Survey Circular 1155, Marlborough, MA.

Godfrey, P.J., M. Mattson, M.F. Walk, P. Kerr, O.T. Zajicek, and A. Ruby III. 1996. *The Massachusetts Acid Rain Monitoring Project: Ten Years of Monitoring Massachusetts Lakes and Streams with Volunteers.* Massachusetts Water Resources Research Center, University of Massachusetts, Amherst, MA, 245 pp.

Gomez and Sullivan. 2004. *Deerfield River Flow Monitoring Study.* Final Report. January 2004. Gomez and Sullivan Engineers, Weare, NH.

Grubbs, G.H. and R.H. Wayland III. 2000. Letter to Colleague dated 24 October 2000. *EPA recommendations on the use of fish and shellfish consumption advisories and certain shellfish growing area classifications in determining attainment of water quality standards and listing impaired waterbodies under section 303(d) of the Clean Water Act*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC.

Howes, B.L., D. White, R. Samimy, and M. Rappacz. 2002. *The Massachusetts Estuaries Project Embayment Water Quality Assessment Interim Report, Priority Embayments 1 – 20.* University of Massachusetts – Dartmouth, School of Science and Technology. Dartmouth, MA.

Halliwell, D.B., W.A. Kimball and A.J. Screpetis. 1982. *Massachusetts Stream Classification Program Part I: Inventory of Rivers and Streams.* Massachusetts Division of Fisheries and Wildlife, Department of Fisheries, Wildlife, and Recreational Vehicles and Massachusetts Division of Water Pollution Control, Department of Environmental Quality Engineering, Westborough, MA.

Harris, S.L. 1997. *Inorganic and organic constituents and grain-size distribution in streambed sediment* and *ancillary data for the Connecticut, Housatonic, and Thames River Basins study unit, 1992-94.* U.S. Geological Survey Open File Report 96-937. National Water-Quality Assessment, Marlborough, MA.

Hogan, P. 2003. Personal Communication. *Deerfield River Basin: NPDES permitting information.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Keller, R. 1999. North River Colrain, Fish Damage Assessment. Memorandum. Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

Leone, D. 1999. Personal Communication. *MA DFA and USFDA EQIP and WHIP projects for landowner best management practices in Franklin County.* Natural Resources Conservation Service, Franklin County Field Office, Greenfield, MA.

LeVangie, D. 2002. *Water withdrawal registration and permit information.* Water Management Act Database. Massachusetts Department of Environmental Protection, Division of Watershed Management, Database Manager. Boston, MA.

Lively, J. 2001. *Water Quality Assessment of the Arms Brook.* Environmental Studies paper, Greenfield Community College, Greenfield, MA.

MA DCR. 2003. *Inventory of Dams in Massachusetts – Deerfield Watershed List* (Electronic database file). Office of Dam Safety, West Boylston, MA.

MA DEM. 2002. *Region 5 (Berkshires) beach bacteria data*. Email from Robert Grahn (Robert.Grahn@state.ma.us), Massachusetts Department of Environmental Management, Office of Forests and Parks, Clinton, MA to Laurie Kennedy, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA dated 4 December 2002.

MA DEM. 1993. *Areas of Critical Environmental Concern (ACEC) Program Guide June 1993.* Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Management, ACEC Program, Boston, MA.

MA DEP. 1996a (Revision of 1995 report). *Massachusetts Surface Water Quality Standards.* Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch, Westborough, MA 114p. (Revision of 314 CMR 4.00, effective June 23, 1996.)

MA DEP. 1996b. Open File. *Department of Watershed Management - Habitat assessment and fish population survey field sheets.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1996c. *Indicative Project Summaries. Section 319 NPS Program 1990 to 1996.* Massachusetts Department of Environmental Protection, Office of Watershed Management, Grafton MA.

MA DEP. 1997. Open File. *Department of Watershed Management - Habitat Assessment and Fish population survey field sheets.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999a. *Final Massachusetts Section 303(d) List of Waters 1998.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 1999b. Open File. *Department of Watershed Management 305(b) Assessment* Guidance*.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MA DEP. 2001a. Open File. *PALIS updates.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2001b. *Open NPDES permit files.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DFWELE. 2000. *Designated Shellfish Growing Areas Datalayer – July 2000.* Published by MassGIS, Executive Office of Environmental Affairs, Department of Fisheries, Wildlife, and Environmental Law Enforcement, Division of Marine Fisheries, Boston, MA.

MA DFWELE. 2002. Lakes Survey for TMDL Development 2000-2002. Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Field Headquarters, Westborough, MA

MA DPH. 1969. *Article 7 Regulation 10.2B of the State Sanitary Code.* Massachusetts Department of Public Health, Boston, MA.

MA DPH. 1996. *Freshwater Fish Consumption Advisory List.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

MA DPH. 2001. *Public Health Statewide Fish Consumption Advisory issued July 2001.* The Commonwealth of Massachusetts, Bureau of Environmental Health Assessment, Boston, MA.

MA DPH. 2001b. *Massachusetts Bathing Beach Database for 2001*. Massachusetts Department of Public Health, Boston, MA.

MA DPH. 2002a. *Freshwater Fish Consumption Advisory List.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

MA DPH. 2002b. *105 CMR 445.000: Minimum Standards For Bathing Beaches, State Sanitary Code, Chapter VII*. Massachusetts Department of Public Health, Division of Community Sanitation Regulations and Statutes [Online] http://www.state.ma.us/dph/dcs/csanregs.htm. 19 September 2002.

MA DPH. 2002c. *Beach Closure/reopening information (attachment: access database "beaches.zip" containing 2001 and 2002 data).* Email from Jennifer Murphy (jennifer.Murphy@state.ma.us.) Massachusetts Department of Public Health, Boston MA to Laurie Kennedy, Massachusetts Department of Environmental Protection, Division of Watershed Management dated 18 November 2002.

Maher, A. 2001. *NHESP Certified Vernal Pools Database (1 January 2001).* Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, Natural Heritage & Endangered Species Program, Westborough, MA.

Maietta, R.J. and J. Colonna-Romano. 2001. *2000 Fish Toxics Monitoring Public Requests and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassGIS. 1999. *Priority Resource Maps.* MassGIS (MA Office of Geographic and Environmental Information), Executive Office of Environmental Affairs, Boston, MA.

MassGIS. 2001. *Hydrography - statewide 1:25000*. MassGIS (MA Office of Geographic and Environmental Information), Executive Office of Environmental Affairs, Boston, MA.

MassWildlife. 2001. *Draft April 2001 Coldwater Fisheries Resource List*. Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement, Division of Fisheries and Wildlife, Westborough, MA.

Mattson, Mark. 2000. Personal Communication regarding Deerfield River Watershed, Lakes TMDL Information. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Mattson, Mark. 2003a. Personal Communication. *Connecticut River Nutrient Loading Study - Deerfield River Nutrient Sampling.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Mattson, Mark. 2003b. Personal Communication regarding Deerfield River Watershed Lake TMDL Status. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Mattson, M.D., P.J. Godfrey, R.A. Barletta and A. Aiello. 2004. *Eutrophication and Aquatic Plant Management in Massachusetts Final Generic Environmental Impact Report.* Edited by Kenneth J. Wagner. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA and Massachusetts Department of Conservation and Recreation, Boston, MA.

Metcalfe, R. 2002. *Optical Brightener Testing of Cherry Rum Brook In Greenfield Massachusetts.* Environmental Studies Paper. Greenfield Community College, Greenfield, MA.

Mitchell, P. 2003. *Role of Watershed Characteristics on Mercury Burdens in Aquatic Macroinvertebrates and Blacknose Dace (Rhinichthys atratulus) of the Deerfield River Watershed, Massachusetts and Vermont.* University of Massachusetts at Amherst. December 2003.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the protection* and *management of aquatic sediment quality in Ontario.* Water Resources Branch, Ontario Ministry of the Environment, Ontario, Canada.

Peters, D. 2003. Charlemont WWTP facility operator - Personal telephone communication with C. Duerring at Massachusetts Department of Environmental Protection, Division of Watershed Management regarding Charlemont WWTP facility information.

Richards, Todd. 2003. Personal communication regarding Deerfield River fish population data with Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Rose, J., M. Hutcheson, C. Rowan West, O. Pancorbo, K. Hulme, A. Cooperman, G. DeCesare, R. Isaac, and A. Screpetis. 1999. *Fish Mercury Distribution in Massachusetts, USA Lakes*. Environmental Toxicology and Chemistry, Vol 18, N0. 7, pp. 1370-1379.

Serrentino, P. 2003. *Japanese Knotweed Inventory of Selected Tributaries of the Deerfield River.* Deerfield River Watershed Association, Shelburne Falls, MA.

Shields, S. 2001. Town of Greenfield Department of Public Works - Personal telephone communication with C. Duerring at Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA regarding impacts on water quality from an auto junk yard in Guilford VT along the Green River.

Shields, S. 2003a. Town of Greenfield Department of Public Works - Personal telephone communication with C. Duerring at Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA regarding Greenfield Municipal Swimming Pool beach sampling results.

Shields, S. 2003b. Town of Greenfield Department of Public Works - Personal telephone communication with C. Duerring at Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA regarding Greenfield Maple Brook sewer project.

Skalka, J. 1999. *Optical Brightener Testing in the Maple Brook, Greenfield, Massachusetts.* Department of Wildlife and Fisheries Conservation, Masters Paper, University of Massachusetts, Amherst MA.

Socolow, R.S., J.F. Whitely, D. Murino Jr., and L.R. Ramsbey. 2001. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 2000.* U.S.Geological Survey Report MA-RI-00-1. Water Resources Division, Northboro, MA.

Stein, E.D., Y. Cohen, and A.M. Winer. 1996. *Environmental Distribution and Transformation of Mercury Compounds*. Critical Reviews in Environmental Science and Technology 26(1):1-43.

Tatsutani, M. Editor. 1998. *Northeast States/Eastern Canadian Provinces Mercury Study A Framework for Action.* Northeast States for Coordinated Air Use Management (NESCAUM), Northeast Waste Management Official's Association (NEWMOA), New England Interstate Water Pollution Control Commission (NEIWPCC), and Canadian Ecological Monitoring and Assessment Network (EMAN).

UMass Amherst. 1999. *Land Use Datalayer - statewide 1:25000.* Published by MassGIS (MA Office of Geographic and Environmental Information), Executive Office of Environmental Affairs for the Resource Mapping Project at the University of Massachusetts Amherst, MA.

USGS. 2003. *Estimated 7Q10 for the Deerfield River gages.* [Online] http://ststdmamrl.er.usgs.gov/streamstats/expert.htm. July 2003.

US Census Bureau. 2003. *Population data*. [Online] http://factfinder.census.gov/. July 2003.

VT DEC. 1992. *Comprehensive River Plan for the Deerfield River Watershed.* Vermont Department of Environmental Conservation, Waterbury, VT. November 1992.

VT DEC. 2003. *Basin 12: Deerfield River Watershed Assessment Report*. Vermont Department of Environmental Conservation, Waterbury, VT. March, 2003.

Walk, Francoise. 2003. *Bear River Stream Crossings Survey*. Deerfield River Current. Winter/Spring 2003.

Wayland III, R.H. 2001. Memorandum to EPA Regional Water Management Directors, EPA Regional Science and Technology Directors, and State, Territory and Authorized Tribe Water Quality Program Directors dated 19 November 2001. Re: *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC.

Yuretich, R. F., D. Ahlfeld, S. Ergas, A. Feldman, and K. Nusslein. In preparation. Biogeochemistry and Natural Attenuation of Acid-Mine Drainage at Davis Pyrite Mine, Rowe, MA. Department of Geosciences. University of Massachusetts, Amherst, MA.

Zimmerman, M. 1999. *Pesticides in Surface Water in the Connecticut, Housatonic, and Thames River Basins, 1992-1995.* U.S. Geological Survey Water Resources Investigations Report 98-4247. National Water-Quality Assessment, Northborough, MA.

LIST OF APPENDICES WITH TABLES AND FIGURES

APPENDIX A

Technical Memorandum TM-33-5

DEERFIELD WATERSHED 2000
DWM WATER QUALITY MONITORING DATA

December 2003

DWM Control Number (CN): 189.0

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Ellen Roy Herzfelder, Secretary
Massachusetts Department of Environmental Protection
Robert W. Golledge, Jr., Commissioner
Bureau of Resource Protection
Cynthia Giles, Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

INTRODUCTION AND PROJECT OBJECTIVES

The Deerfield Watershed environmental monitoring plan for 2000 was developed by the monitoring subgroup of the EOEA Deerfield Watershed Team in consultation with DWM. Subwatersheds were evaluated for their water and habitat quality data needs using information gathered by the team in 1999, and monitoring strategies were developed to address those needs. Priority monitoring needs addressed by DWM included sampling for water chemistry, macroinvertebrate biomonitoring, fish population studies, and fish toxics monitoring. This technical memorandum presents the riverine water quality sampling component of the survey. Results of the other monitoring efforts conducted in 2000 by DWM are described in separate memoranda or reports.

The 1995-6 DWM Deerfield Watershed water quality survey identified several segments that lacked sufficient water quality data for evaluation and also flagged several sites with potential water quality problems that needed more water chemistry data for adequate assessment. Several sites were also identified for sampling in order to maintain an historical database to evaluate long-term trends. To address some of these water quality sampling needs, DWM conducted three water quality sampling surveys from July through October 2000 at three sites along the mainstem Deerfield River and 9 sites on five tributaries. Samples were analyzed in the field for D.O., temperature, pH, conductivity, total dissolved solids (TDS), and percent saturation. Samples for alkalinity, nutrients, hardness and total suspended solids (TSS) were collected for analysis at the state's analytical laboratory, the Wall Experiment Station (WES). The Massachusetts EOEA also funded a concurrent water and sediment quality study conducted for the EOEA Deerfield Watershed Team as an annual workplan project. The study was conducted by Environmental Sciences Inc. (ESS) and involved six water quality sampling surveys from August through November at two sites on the mainstem Deerfield and 19 stations along a number of its tributaries. Six of the sampling sites were the same as DWM stations. Samples were analyzed for fecal coliform bacteria, temperature, pH, conductivity, and turbidity. ESS also collected sediment sampling behind six of the impoundments on the mainstem Deerfield River. Samples were analyzed for selected metals, PCBs, PAHs, TPH, % TOC, % volatile solids, and % water. Results from the ESS, Inc. study are published in a separate report (ESS, Inc. 2002).

QUALITY ASSURANCE AND QUALITY CONTROL

A QAPP was not written for the Deerfield water quality sampling surveys in 2000, however, procedures used were consistent with the prevailing DWM sampling protocols that are described in the *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MA DEP 1999a; CN 1.0). While no field audits were performed in 2000, wade-in grab samples were assumed to be representative and to have been taken consistent with DWM SOPs (in lieu of information to the contrary). For all water quality surveys, quality control samples (field blanks and sample splits) were taken at a minimum of one each per crew per survey. All water quality samples were delivered to the WES laboratory for analysis.

DWM quality assurance and database management staff reviewed lab data reports and all Hydrolab multi-probe data. The data were validated and finalized per data validation procedures outlined in DWM SOP CN 56.0 (MA DEP, 2001). In general, all water sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). A complete summary of censoring and qualification decisions for 2000 DWM data is provided in the DWM 2000 Data Validation Report (MA DEP, 2003; CN 83.0). Appendix A1 of this technical memorandum contains data censoring/qualification decisions for 2000 Deerfield data. Definitions for the data qualifiers are also included in Appendix A1. This information was excerpted from the DWM 2000 Data Validation Report (MA DEP, 2003; CN 83.0).

SURVEY METHODS

DWM personnel performed *in-situ* water quality measurements for D.O., temperature, pH, conductivity, TDS, and percent saturation with a *Hydrolab® Series 3 Multiprobe* and collected water samples for alkalinity, nutrients, hardness and TSS for laboratory analysis at 12 stations (Table A1 and Figure A1) on July 25, 2000, August 29, 2000 and October 17, 2000. Each survey crew also took a minimum of one ambient field blank and one field split sample for quality control purposes. Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MA DEP, 1999a; CN 1.0) and *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure* (MA DEP 1999b; CN 4.0). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were transported on ice to WES where they were analyzed by methods according to the WES Standard Operating Procedure (SOP).

Table A1. 2000 DEP-DWM Deerfield River Watershed survey. Location of sites sampled for water quality analysis on July 25, 2000, August 29, 2000 and October 17, 2000.

STREAM	STATION (UNIQUE ID)	SEGMENT NO.	DESCRIPTOR
Deerfield River	UD01 (4)	MA 33-01	approximately 800 feet below Fife Brook Dam, Florida
Chickley River	CH (40)	MA 33-11	upstream of Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont
Deerfield River	DR03 (761)	MA 33-02	at USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont
North River	NR03 (21)	MA 33-06	under Rt 112 bridge south of Griswoldville, Colrain
North River	NR04 (22)	MA 33-06	upstream of Adamsville Road bridge, Colrain
Green River	GR07 (7)	MA 33-28	USGS gage #01170100, north of East Colrain
Green River	GR07A	MA 33-28	duplicate sample - USGS gage north of East Colrain
South River	SO05 (756)	MA 33-08	under bridge at Bullit Road, Ashfield
South River	SO-8 (9)	MA 33-08	upstream of bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway
Deerfield River	DR10 (757)	MA 33-04	downstream of Rt 5 – 10 bridge, Deerfield (southern channel of river)
Green River	GR03 (759)	MA 33-29	approximately 60 feet downstream of dam under Mill Street, Greenfield
Green River	GR03A	MA 33-30	duplicate sample – 60 feet downstream of dam under Mill Street, Greenfield
Green River	GR02 (758)	MA 33-30	midstream, approximately 150 feet upstream of confluence with Deerfield River, Greenfield
Unnamed Tributary to Green River (aka Maple Brook)	MB01 (760)	Trib. to MA 33-30	behind trailer park approximately 75 feet downstream of rock face where culverted stream emerges, Greenfield

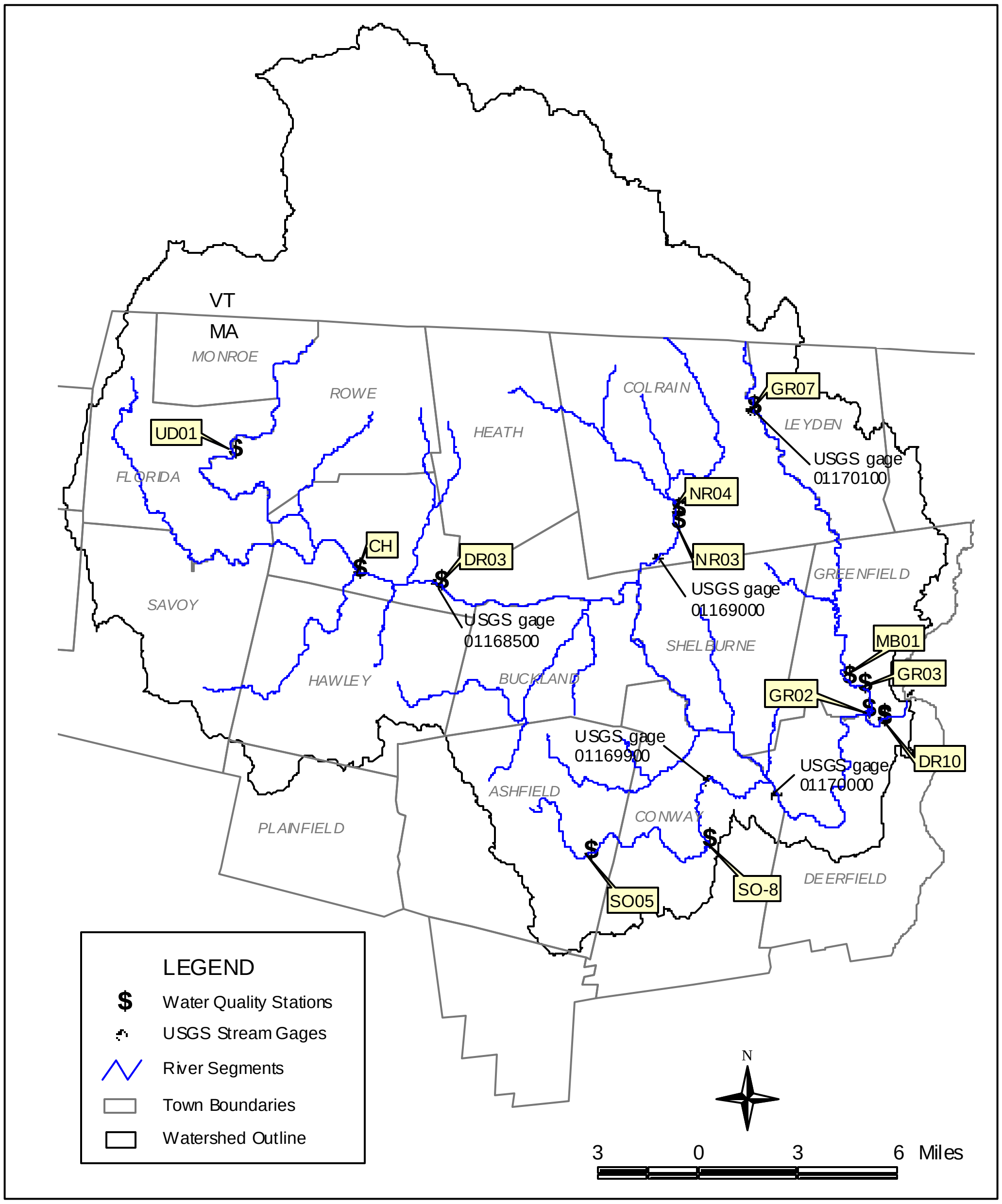

Figure A1. Location of 2000 MA DEP water quality sampling stations and USGS gaging stations in the Deerfield River Watershed.

SURVEY CONDITIONS

Conditions prior to each survey were characterized by analyzing precipitation and streamflow data. Rainfall data from two DEM Office of Water Resources precipitation stations (Greenfield station #203 and Heath station MWRC #201), one NOAA/National Weather Service precipitation station (Ashfield station) was reviewed for the five days prior to and on the sampling dates (Table A2) (MA DEM 2000). Streamflow data (Tables A3 – A7) used to estimate hydrological conditions for the water quality sampling events were obtained from two USGS stream gages on the Deerfield River (No. 01170000 at West Deerfield and No. 01168500 in Charlemont), one on the North River (No. 01169000 at Shattuckville), one on the South River (No. 01169900 in Conway) and one on the Green River (No. 01170100 in Colrain) as reported in the USGS 2000 and 2001 water year compilations. Locations of the gages are illustrated in Figure A1. Streamflow statistics for these gages are available from USGS (Socolow *et al.* 2001 and 2002 and USGS 1998). It should also be noted that flows in the mainstem Deerfield River are heavily regulated by hydropower facilities, including minimum flow requirements and white-water boating releases. Tributary flows may also be affected by dams (including beaver), therefore data should be interpreted with caution. Streamflow conditions were also compared in relation to the 7-day, 10-year (7Q10) low flow estimates.

Survey conditions are described below for each DWM sampling event:

July 25, 2000: This survey was conducted during and following relatively dry weather (Table A2). A small amount of precipitation was recorded in Greenfield (0.21 inches) and fell on the third antecedent day of the sampling event. Streamflow recorded on the sampling date at USGS gages in the South River (#01169900) and North River (#01169000) was above the monthly averages for their respective periods of record, but significantly below the monthly average recorded for July (Tables A4 and A5). Streamflow recorded at the Green River gage (#01170100) was similar to the monthly average for the period of record, but lower than the July monthly mean flow (Table A7). Flows on the sampling date at the tributary gages were substantially above the 7Q10 low flow estimates (9 – 15 times higher). Flows at all except the Deerfield mainstem gages were declining during the five days prior to the sampling event. Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flow recorded on the sampling date from the mainstem West Deerfield gage (#01170000) was almost three times higher than the average monthly period of record flow and at the Charlemont gage (#01168500) they were over twice as high, but again the flows on the sampling date were much lower than the July monthly average (Tables A3 and A6). What likely contributed to the high July monthly flow averages was an unusual weather phenomenon recorded by the National Weather Service that occurred in the northern part of Berkshire County near the Vermont border on the 16th of July (nine days before the sampling event). Radar estimated that nearly 9 inches of rain fell in less than 8 hours. Severe flash flooding occurred in Heath and Rowe. In Colrain, as a result of this storm, the North River crested about one half foot above flood stage. Based on maps contained in the Rainfall Frequency Atlas for the Northeast (U.S. Department of Commerce), this event appears to have been on the order of a 100-year 24-hour rainfall (L. Marler, MA DRC, personal communication). Data collected during this survey are interpreted as being representative of dry weather conditions

August 29, 2000: This survey was conducted during and following relatively dry weather (Table A2). A small amount of precipitation fell (0.33 inches) at the Greenfield site on the fifth day prior to the survey. Streamflow recorded on the sampling date at USGS gages in the North River (#01169000), South River (#01169900) and Green River (#01170100) was above the monthly averages for their respective periods of record, but significantly below the monthly average recorded for August (Tables A4, A5, and A7). Flows on the sampling date at the tributary gages were substantially above the 7Q10 low flow estimates (12 – 14 times higher). Flows at all except the Deerfield mainstem gages were declining during the five days prior to the sampling event. Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flow recorded on the sampling date from the mainstem West Deerfield gage (#01170000) was almost three times higher than the average monthly period of record flow and at the Charlemont gage (#01168500) they were over twice as high (Tables A3 and A6). Data collected during this survey are interpreted as being representative of dry weather conditions.

October 17, 2000: The weather conditions during, and five-days prior to the sampling event were variable. A small amount of rainfall (0.08") was recorded at the Heath site 5 days prior to the survey and 0.21" fell in Ashfield one day before the survey. On the day of the survey 0.21" of rain was recorded in Greenfield (Table A2). Streamflow recorded on the sampling date at USGS gages in the North River (#01169000) and South River (#01169900) was similar to the October monthly mean and the monthly averages for their respective periods of record (Table A4 and A5). However, the discharge at the Green River gage (#01170100) was significantly less than the October monthly mean and the monthly average for the period of record (Table A7). Flows at all three tributary gages were 12% to 36% higher on the sampling date than the flows recorded two days prior to the sampling event and were substantially above the 7Q10 low-flow estimates (5 – 16 times higher). Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flows at both gages (#01170000 and #01168500) exceeded the average monthly period of record flow and the mean monthly flow for October (Tables A3 and A6). Because of only slight increases in streamflow at the tributary gages on the date of sampling and the small amount of recorded precipitation that fell prior to and on the day of sampling at only one of the three observation sites, data collected during the survey are being interpreted as representative of predominately dry weather conditions.

Table A2: Deerfield River Basin 2000 Precipitation Data Summary (reported in inches of rainfall)																		
Survey Dates	5 Days Prior			4 Days Prior			3 Days Prior			2 Days Prior			1 Day Prior			Sample Date		
	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld
25 Jul	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 Aug	0.00	MFR	0.33	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00
17 Oct	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.21
MFR-Missing from record, T= trace amounts, DEM Office of Water Resources precipitation stations: Hth = Heath; Gfld = Greenfield, NOAA/NWS precipitation station: Afld = Ashfield																		

Table A3: Deerfield River at Charlemont, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01168500								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	794	869	795	550	1090	988	1353	454
29 Aug	1340	1190	1180	1110	832	1070	1374	461
17 Oct	782	666	362	314	455	1050e	626	606
7Q10 @ USGS, Gage 01168500 = 34 cfs, *Period of Record: 1913 - present (mean annual discharge = 902 cfs), e = estimated								

Table A4: North River at Shattuckville, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01169000								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	222	173	155	127	108	97	316	69.5
29 Aug	343	184	141	137	103	90	285	52.4
17 Oct	94	86	81	76	80	104	129	101
7Q10 @ USGS, Gage 01169000 = 6.3 cfs, *Period of Record: 1940 - present (mean annual discharge = 299 cfs), e = estimated								

Table A5: South River near Conway, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01169900								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	43	39	51	35	30	28	80.7	22.6
29 Aug	70	44e	36	32	30	29	91.9	18.8
17 Oct	19	18	17	16	17	25	24.3	29.5
7Q10 @ USGS, Gage 01169900 = 2.0 cfs, *Period of Record: 1966 - present (mean annual discharge = 53.4 cfs), e = estimated								

Table A6: Deerfield River near West Deerfield, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01170000								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	1500e	1200e	900e	800e	1600e	1500e	1955	586
29 Aug	1880	1590	1400	1380	992	1320	1911	573
17 Oct	977	937	498	418	582	955	835	842
7Q10 @ USGS, Gage 01170000 = 39 cfs, *Period of Record: 1904 - present (mean annual discharge = 1318 cfs), e = estimated								

Table A7: Green River near Colrain, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01170100								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	67	54	49	40	36	32	84.2	36.5
29 Aug	127	75	61	53	47	42	126	27.9
17 Oct	12	13	14	15	16	17	55.9	49.8
7Q10 @ USGS, Gage 01170100 = 3.6 cfs, *Period of Record: 1968 - present (mean annual discharge = 90.4 cfs), e = estimated								

WATER QUALITY DATA

Raw data files, field sheets, lab reports and chain of custody (COC) records are stored in open files at the Division of Watershed Management (DWM) in Worcester. All DEP DWM water quality data are managed and maintained in the *Water Quality Data Access Database*.

Table A8. 2000 MA DEP Deerfield River Watershed *in-situ* Hydrolab® Data.
Temperature, pH, Conductivity, Total Dissolved Solids, Dissolved Oxygen, % Saturation (Data qualifiers listed in Appendix A1)

UNNAMED TRIBUTARY (Saris: 9253500)
Station: MB01, Mile Point: 0.1, Unique ID: 760
Description: Unnamed tributary to Green River approximately 75 feet from bottom of rock face where culverted stream (locally known as Maple Brook) emerges, south of Colrain Street, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0207	0641	0.2	16.4	7.5 c	606	388	9.1	91
8/29/2000	33-0231	0651	0.2	17.1	7.6 c	563	360	8.9	90
10/17/2000	33-0239	0634	0.3	13.2	7.4 c	379	243	9.0	83

DEERFIELD RIVER (Saris: 3312900)
Station: UD01, Mile Point: 38.9, Unique ID: 4
Description: Approximately 800 feet below Fife Brook Dam, Florida

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0208	0410	0.7	16.1	6.2	36.6	23.4	9.1	90
8/29/2000	33-0216	0354	0.4	17.0	5.8	33.7	21.5	8.5	86
10/17/2000	33-0240	0408	0.4	12.7	6.5	35.2	22.5	9.8	90

Table A8 (continued)

DEERFIELD RIVER (Saris: 3312900)
Station: DR03, Mile Point: 25.9, Unique ID: 761
Description: At USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0210	0528	0.6	15.6	6.7	43.1	27.6	9.3	91
8/29/2000	33-0218	0506	0.5	16.7	6.4	37.8	24.2	9.6	97
10/17/2000	33-0242	0522	0.6	11.2	6.8	39.5	25.3	10.7	95

DEERFIELD RIVER (Saris: 3312900)
Station: DR10, Mile Point: 1.1, Unique ID: 757
Description: Downstream/east of Rte. 5/10 Bridge, Deerfield (southern channel of river)

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0202	0506	0.5	17.9	6.8	63.3	40.5	9.2	95
8/29/2000	33-0226	0519	0.6	18.7	6.9	68.8	44.0	8.9	93
10/17/2000	33-0234	0507	0.4	11.9	7.1 c	81.2	52.0	10.5	94

GREEN RIVER (Saris: 3312925)
Station: GR07, Mile Point: 14.2, Unique ID: 7
Description: At USGS gage # 01170100, north of East Colrain, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0213	0713	0.4	15.3	7.7 c	87.1	55.8	9.4	91
8/29/2000	33-0221	0640	0.4	16.0	7.3 c	101	64.7	9.9	98
10/17/2000	33-0245	0719	0.5	8.1	7.7 c	94.7	60.6	11.6	95

GREEN RIVER (Saris: 3312925)
Station: GR03, Mile Point: 1.5, Unique ID: 759
Description: Approximately 60 feet downstream/southeast from dam under Mill Street, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0204	0617	0.4	19.2	7.4 c	142	90.8	9.2	97
8/29/2000	33-0228	0624	0.6	18.3	7.4 c	147	93.9	9.4	97
10/17/2000	33-0236	0609	0.5	9.8	7.5 c	147	94.1	10.9	93

GREEN RIVER (Saris: 3312925)
Station: GR02, Mile Point: 0.03, Unique ID: 758
Description: Midstream, approximately 150 feet upstream/northeast of confluence with Deerfield River, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0203	0540	0.3	19.0	7.4 c	145	92.7	9.1	96
8/29/2000	33-0227	0549	0.3	18.8	7.5 c	149	95.0	9.1	95
10/17/2000	33-0235	0539	0.5	10.1	7.5 c	148	94.5	11.0	95

SOUTH RIVER (Saris: 3313650)
Station: SO05, Mile Point: 11.1, Unique ID: 756
Description: Under bridge at Bullitt Road, Ashfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0200	0343	** I	14.8	7.5 c	160	102	10.0	96
8/29/2000	33-0225	0359	** I	14.9	7.4 c	157	100	9.9	96
10/17/2000	33-0233	0356	** I	8.2	7.5 c	152	97.0	11.6	96

Table A8 (continued)

SOUTH RIVER (Saris: 3313650)
Station: SO-8, Mile Point: 5.1, Unique ID: 9
Description: At bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0201	04:21	0.1 i	17.0	7.4 c	138	88.0	9.4	95
8/29/2000	33-0225	04:33	0.2	16.9	7.4 c	139	89.1	9.3	93
10/17/2000	33-0233	04:23	0.3	9.0	7.4 c	145	92.7	11.3 u	95 u

NORTH RIVER (Saris: 3314100)
Station: NR04, Mile Point: 3, Unique ID: 22
Description: Adamsville Road bridge, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0212	06:33	0.9	15.2	7.3 c	84.6	54.2	9.4	92
8/29/2000	33-0220	06:02	0.4	16.3	7.1 c	90.8	58.1	9.8	97
10/17/2000	33-0244	06:28	0.5	8.4	7.3 cu	84.7	54.2	11.4	94

NORTH RIVER (Saris: 3314100)
Station: NR03, Mile Point: 2.6, Unique ID: 21
Description: Route 112 bridge south of Griswoldville, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0211	06:08	0.4	15.5	7.4 c	119	76.2	9.3	91
8/29/2000	33-0219	05:40	0.1 i	16.6	7.1 cu	105	67.2	9.7	97
10/17/2000	33-0243	06:04	0.4	8.5	7.4 c	110	70.3	11.5	96

CHICKLEY RIVER (Saris: 3315425)
Station: CH, Mile Point: 0, Unique ID: 40
Description: Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0209	05:05	0.2	14.9	7.2 c	53.8	34.4	9.3	90
8/29/2000	33-0217	04:41	** i	15.8	6.9 u	48.4	31.0	10.0	98
10/17/2000	33-0241	04:50	0.3	8.2	7.1 cu	47.9	30.7	11.6	95

Field Blank Sample
Station: BLANK
Description: QAQC: Field Blank Sample

Date	OWMID	QAQC	Time	Fecal Coliform
			24hr	(cfu/100ml)
8/29/2000	83-0222	BLANK	09:26	<10
8/29/2000	83-0233	BLANK	11:20	<10
9/18/2000	83-0246	BLANK	10:07	<5
9/18/2000	83-0257	BLANK	11:30	<5

Table A9. 2000 MA DEP Deerfield River Watershed Instream Physico/Chemical Data.
Alkalinity, Hardness, Total Suspended Solids (TSS), Turbidity, Ammonia Nitrogen, Nitrate-Nitrite Nitrogen, Total Phosphorus (Data qualifiers listed in Appendix A1)

Field Blank Sample
Station: BLANK
Description: QAQC: Field Blank Sample

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0206	BLANK	06:17	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
7/25/2000	33-0215	BLANK	07:13	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
8/29/2000	33-0230	BLANK	06:24	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
8/29/2000	33-0223	BLANK	06:40	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
10/17/2000	33-0238	BLANK	06:12	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
10/17/2000	33-0247	BLANK	07:19	23 b	28 b	<1.0	1.3 b	<0.02	<0.02	** m

Unnamed Tributary
Station: MB01, Mile Point: 0.1, Unique ID: 760
Description: Unnamed tributary to Green River approximately 75 feet downstream from bottom of rock face where culverted stream (locally known as Maple Brook) emerges, south of Colrain Street, Greenfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0207		06:41	85	130	1.1	2.7	0.10	1.9	0.050
8/29/2000	33-0231		06:51	79	140	<1.0	1.6	0.14	2.2	0.039
10/17/2000	33-0239		06:34	60	88	2.6	6.0	<0.02	1.6	0.18

DEERFIELD RIVER (Saris: 3312900)
Station: UD01, Mile Point: 38.9, Unique ID: 4
Description: Approximately 800 feet below Fife Brook Dam, Florida

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0208		04:10	4	8.3	2.3	2.4	<0.02	0.12	0.013
8/29/2000	33-0216		03:53	5	7.6	<1.0	1.3	<0.02	0.09	0.012
10/17/2000	33-0240		04:08	3 b	8.2 b	1.2	1.2 b	<0.02	0.11	0.012

DEERFIELD RIVER (Saris: 3312900)
Station: DR03, Mile Point: 25.9, Unique ID: 761
Description: At USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0210		05:28	4	10	1.4	1.7	<0.02	0.12	0.014
8/29/2000	33-0218		05:06	6	8.9	1.8	1.1	<0.02	0.10	<0.010
10/17/2000	33-0242		05:22	7 b	10 b	1.9	1.2 b	<0.02	0.10	0.011

DEERFIELD RIVER (Saris: 3312900)
Station: DR10, Mile Point: 1.1, Unique ID: 757
Description: Downstream/east of Route 5-10 bridge, Deerfield (southern channel of river)

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	TKN	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0202		05:06	11	17	5.7	3.0	0.23	<0.02	0.25	0.022
8/29/2000	33-0226		05:19	15	19	3.4	1.3	0.19	<0.02	0.24	0.020
10/17/2000	33-0234		05:07	17	23	1.4	0.69	0.19	<0.02	0.22	0.018

Table A9 (continued)

GREEN RIVER (Saris: 3312925)
Station: GR07, Mile Point: 14.2, Unique ID: 7
Description: At USGS gage #01170100, north of East Colrain, in Colrain

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0213	33-0214	07:13	32	36	<1.0	0.25	<0.02	0.06	<0.010
7/25/2000	33-0214	33-0213	07:13	31	36	<1.0	0.20	<0.02	0.04	<0.010
8/29/2000	33-0221	33-0222	06:40	36	43	<1.0	0.20	<0.02	0.07	<0.010
8/29/2000	33-0222	33-0221	06:40	38	44	<1.0	0.20	<0.02	0.07	<0.010
10/17/2000	33-0245	33-0246	07:19	26 bd	41 b	<1.0	0.45 b	<0.02	<0.02	<0.010
10/17/2000	33-0246	33-0245	07:19	35 bd	42 b	<1.0	0.35 b	<0.02	<0.02	<0.010

GREEN RIVER (Saris: 3312925)
Station: GR03, Mile Point: 1.5, Unique ID: 759
Description: Approximately 60 feet downstream/southeast from dam under Mill Street, Greenfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0204	33-0205	06:17	41	49	4.4	2.2	<0.02	0.20	0.016
7/25/2000	33-0205	33-0204	06:17	41	49	3.9	2.6	<0.02	0.20	0.020
8/29/2000	33-0228	33-0229	06:24	43	53	2.9	1.4	<0.02	0.19	0.014
8/29/2000	33-0229	33-0228	06:24	40	52	2.2	1.5	<0.02	0.20	0.014
10/17/2000	33-0236	33-0237	06:09	45	53	1.8	1.1	<0.02	0.24	0.011
10/17/2000	33-0237	33-0236	06:09	46	53	1.6	1.1	<0.02	0.24	0.012

GREEN RIVER (Saris: 3312925)
Station: GR02, Mile Point: 0.03, Unique ID: 758
Description: Midstream, approximately 150 feet upstream/northeast of confluence with Deerfield River, Greenfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0203		05:40	41	49	3.6	2.0	<0.02	0.26	0.015
8/29/2000	33-0227		05:49	42	53	1.8	1.2	0.33 r	0.20	0.013
10/17/2000	33-0235		05:39	44	53	1.8	1.2	<0.02	0.25	0.013

SOUTH RIVER (Saris: 3313650)
Station: SO05, Mile Point: 11.1, Unique ID: 756
Description: Under bridge at Bullitt Road, Ashfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0200		03:43	38	49	<1.0	0.55	<0.02	0.54	0.016
8/29/2000	33-0224		03:59	37	49	<1.0	0.55	<0.02	0.46	0.016
10/17/2000	33-0232		03:56	38	48	<1.0	0.26	<0.02	0.38	<0.010

SOUTH RIVER (Saris: 3313650)
Station: SO-8, Mile Point: 5.1, Unique ID: 9
Description: At bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0201		04:21	38	45	<1.0	0.60	<0.02	0.34	0.011
8/29/2000	33-0225		04:33	39	47	<1.0	0.35	<0.02	0.30	0.010
10/17/2000	33-0233		04:25	43	49	<1.0	0.60	<0.02	0.19	<0.010

Table A9 (continued)

NORTH RIVER (Saris: 3314100)
Station: NR04, Mile Point: 3, Unique ID: 22
Description: Adamsville Road bridge, Colrain

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0212		06:33	22	28	1.8	3.1	<0.02	0.36	0.017
8/29/2000	33-0220		06:02	26	32	<1.0	0.50	<0.02	0.30	<0.010
10/17/2000	33-0244		06:28	27 b	31 b	<1.0	0.88 b	<0.02	0.15	<0.010

NORTH RIVER (Saris: 3314100)
Station: NR03, Mile Point: 2.6, Unique ID: 21
Description: Route 112 bridge south of Griswoldville, Colrain

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0211		06:08	24	29	2.1	2.8	<0.02	0.50	0.038
8/29/2000	33-0219		05:40	27	32	5.4	0.55	<0.02	0.36	0.020
10/17/2000	33-0243		06:04	27 b	32 b	<1.0	1.2 b	<0.02	0.19	0.019

CHICKLEY RIVER (Saris: 3315425)
Station: CH, Mile Point: 0, Unique ID: 40
Description: Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0209		05:05	16	20	<1.0	0.20	<0.02	0.12	0.031
8/29/2000	33-0217		04:41	15	18	<1.0	0.20	<0.02	0.10	<0.010
10/17/2000	33-0241		04:50	13 b	18 b	<1.0	0.35 b	<0.02	<0.02	<0.010

REFERENCES

ESS, Inc. 2002. W*ater and Sediment Quality Assessment of the Deerfield River Watershed.* (EOEA Project No. SC ENV 1000 0180512). Wellesley, MA.

Marler, L. November 2003. Personal Communication. Massachusetts Department of Conservation and Recreation, Boston MA.

MA DEM. 2000. Open File. *Monthly Precipitation Report.* Massachusetts Executive Office of Environmental Affairs, Department of Environmental Management, Boston, MA.

MA DEP. 1995. January Draft. *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station, Lawrence, MA.

MA DEP. 1999a. CN 1.0 *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure*. 25 October 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 1999b. CN 4.0 *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure*. September 23, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2001. CN 56.0 *DWM Data Validation Standard Operating Procedure*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2003. CN 83.0 2000 *Data Validation Report .* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Socolow, R.S., J.S. Whitley, Domenic Murino, Jr., and L.R. Ramsbey. 2001. *Water Resources Data for Massachusetts and Rhode Island, Water Year 2000*. U.S. Geological Survey Report MA-RI-00-1. Water Resources Division, Northborough, MA.

Socolow, R.S., C.R. Leighton, J.F. Whitely, and D.J. Venetuolo. 2002. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 2001.* U.S. Geological Survey Report MA-RI-01-1. Water Resources Division, Northborough, MA.

U.S. Department of Commerce. *Rainfall Frequency Atlas for the Northeast. Technical Papers 40 and 49.* Compiled September 1990 by USDA, Soil Conservation Service, Amherst, MA.

USGS. 1998. Unpublished Data. *Provisional low-flow frequency statistics for gaging stations (3.5" floppy disc).* United States Geological Survey, Water Resources Division, Marlborough, MA.

APPENDIX A1
Quality Assurance/Quality Control Data Validation for the Deerfield Watershed 2000 Water Quality Survey

Excerpted from:
Data Validation Report for Year 2000 Project Data (CN 083.0)

March 5, 2003

Department of Environmental Protection
Division of Watershed Management

5.0 2000 Discrete Water Sample Data

5.1 QA/QC Objectives and Criteria for 2000 Discrete Water Sample Data

The collection and analysis of discrete water samples in 2000 followed the DWM Standard Operating Procedure for grab sampling (CN# 1.0) and analyte-specific WES SOPs. This included the use of rinsed plastic buckets at drop locations and the taking of split samples for estimation of overall precision (QC).

Using the following criteria, as well as other considerations and input from data reviewers, individual datum were accepted, accepted with qualification or censored. In cases where poor quality control (eg. blank/cross contamination, lab accuracy) affected batched analyses or entire surveys, censoring/qualification decisions were applied to groups of samples (eg. a specific crew's samples, a specific survey's samples or all samples from a specific batch analysis).

Criteria for acceptance of discrete water quality samples were as follows:

- For simplicity, samples that were "lost", "missing", "spilled" and "not analyzed" were 'censored' using the 'm' (method not followed) qualifier.

- Sampling/Analysis Holding Time: Each analyte has a standard holding time that has been established to ensure sample/analysis integrity. Refer to DWM Standard Operating Procedure CN# 1.1 for a complete listing. If the standard holding time was exceeded, this criterion is violated and the data may be censored, depending on the extent of exceedance. For very minor exceedances (eg. < than 10% of the holding time), the data is typically qualified ("h" for minor holding time violation).

- Quality Control Sample Frequency: At a minimum, one field blank and one replicate must be collected for every ten samples by any given sampling crew on any given date. If less than 10% blanks and/or replicates were collected, the data may be censored or qualified, based on a review of crew member experience, training and history, as well as other factors relevant to the specific survey.

- Field Blanks: Field blanks were prepared at the DWM Worcester Laboratory. Reagent grade water was transported into the field in a sample container where it was transferred into a different sample container and fixed where necessary using the same method as its corresponding field sample. All blanks were submitted to the WES laboratory "blind". If the field blank results were greater than the MDL, the data may be censored or qualified, depending on extent and other factors.

- Field Replicates: In 2000, field replicate samples were taken as "split" samples, where two independent samples were created from a larger volume sample (not sequential duplicates or co-located duplicates). Both samples were submitted to WES laboratory "blind". In order for this data quality criterion to be met, the results must generally be:

- <20% Relative Percent Difference (RPD) for method detection limits >1mg/L, or
- <30% RPD for method detection limits <1mg/L.

or meet more specific criteria contained in a 2000 QAPP. If the criteria are not met, the data may be censored or qualified, depending on extent of exceedance and other factors. In most cases, poor precision of field split samples reflects potential poor reproducibility for entire surveys and/or analytical batch runs, and may lead to the censoring/qualification of same.

- Laboratory assessment of analytical precision and accuracy: The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. WES staff release discrete water sample data when their established QA/QC criteria have been met. When the following criteria cannot be met, data are qualified as "estimated" (using a "j value) if appropriate, or no data ("ND") is reported:

• Low Calibration Standards – Checks the stability of the instrument's calibration curve; analyzes the *accuracy* of an instrument's calibration within a 5% range.

• Reference Standards – Generally, a second source standard (a standard different from the calibration stock standard) that analyzes the method *accuracy.*

• Laboratory Reagent Blank/Method Blank (LRB) – Reagent grade water (de-ionized) extracted with every sample set used to ensure that the system is free of target analytes (< MDL) and to assess potential blank contamination.

• Duplicate Sample – Measures the *precision* (as Relative Percent Difference or RPD) of the analytical process. The acceptable laboratory %RPD range is typically ≤ 25%.

• Spike Sample (Laboratory Fortified Blank - LFB, Laboratory Fortified Matrix - LFM)– Measures the *accuracy* (% Recovery) of an analytical method. The acceptable laboratory % recovery range is typically between 80 – 120% for LFB samples and 70 –130% for LFM discrete water samples.

5.2 2000 Censored/Qualified Discrete Water Sample Data (by watershed)

All Year 2000 data for discrete water samples that have been censored or qualified are listed below for the Deerfield Watershed, except for missing data. Additional sample information is also provided as needed for accepted data in need of further elaboration/ discussion.

Deerfield Watershed 2000 Censored/Qualified Discrete Water Sample Data

Watershed/ Water body	Sample Date	OWMID #s	Analyte	Censored/ Qualified	Reason
Deerfield	8/29	33-0230, 231, 224, 225, 226, 227, 228 and 229	TP	***Qualify (b)***	Exceedance of MDL for ambient field blank; same crew survey data qualified; (slight exceedance of DQO for RPD for 33-0228 and 229 insufficient for (d) qualifier)
Deerfield	7/25	33-0204 and 205	TP	accept	Slight exceedance of RPD; insufficient for qualification
Deerfield	8/29	33-0228 and 0229	TSS	accept	Slight exceedance of RPD; insufficient for qualification
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	ALK	***Qualify (b)***	Ambient field blank >> MDL; associated survey crew samples qualified
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	Hardness	***Qualify (b)***	Ambient field blank >> MDL; associated survey crew samples qualified
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	Turbidity	***Qualify (b)***	Ambient field blank >> MDL; survey crew samples qualified.
Deerfield	10/17	33-0247	TP	***Censor (m)***	Sample lost at WES
Deerfield	10/17	33-0245, 0246	ALK	***Qualify (d)***	DQO for RPD duplicate (split) precision exceeded.
Deerfield	8/29	33-0227	NH3-N	***Qualify (r)***	Sample may not be representative of field conditions.
Deerfield	7/25	33-0213, 0214	Turbidity	accept	Slight exceedance of DQO for RPD precision due to low number effect; insufficient evidence to censor or qualify
Deerfield	7/25	33-0213, 0214	NO3-N	accept	Slight exceedance of DQO for RPD precision; insufficient evidence to censor or qualify

2000 Data Symbols and Qualifiers (excerpted from CN 83.0, Appendix A)

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and Hydrolab® data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data, including the magnitude or extent of the problem(s).

General Symbols (applicable to all types):

" ** " = Censored or missing data (i.e., data that should have been reported)

" -- " = No data (i.e., data not taken/not required)

" **<mdl** " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (eg. <0.2).

Hydrolab®-specific Qualifiers:

" i " = **i**naccurate readings from Hydrolab® multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses.

Qualification Criteria for Depth (i):

General Depth Criteria: Apply to each OWMID#
- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date
- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, i.e. that all positive readings may be in error.)

" **m "** = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" **s "** = field **s**heet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure.

" **u "** = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" **c** " = greater than **c**alibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for <u>conductivity</u> (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or <u>turbidity</u> (>10, 20 or 40 NTU). It can also be used for <u>TDS and Salinity</u> calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" **?** " = Light interference on Turbidity sensor (Hydrolab® error message). Data is typically censored.

<u>Sample-specific Qualifiers</u>:

" a " = **a**ccuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" **b** " = **b**lank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

" **d** " = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" **e** " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" **f** " = **f**requency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" **h** " = **h**olding time violation (usually indicating possible bias low)

" **j** " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< *x* <rdl). Also used to note where values have been reported at levels less than the mdl.

" **m "** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

" **p** " = samples not **p**reserved per SOP or analytical method requirements.

" **r** " = samples collected may not be **r**epresentative of actual field conditions, based on documented or suspected field sampling error, or inexplicable or improbable ("outliers") values.

APPENDIX B

***Technical Memorandum* TM-33-3**

DEERFIELD RIVER WATERSHED 2000 BIOLOGICAL ASSESSMENT

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Date: 21 October 2002

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Tables and Figures

INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1999, Barbour et al. 1995). Biological surveys and assessments are the primary approaches to biomonitoring.

As part of the Massachusetts Department of Environmental Protection/ Division of Watershed Management's (MA DEP/DWM) 2000 Deerfield River watershed assessments, aquatic benthic macroinvertebrate and fish biomonitoring was conducted to evaluate the biological health of various portions of the watershed. A total of fourteen biomonitoring stations were sampled to investigate the effects of various nonpoint and point source stressors on the aquatic communities of the watershed. Some stations sampled during the 2000 biomonitoring survey were previously "unassessed" by DEP, while historical DEP biomonitoring stations—most recently assessed in 1988 and 1995 (Fiorentino 1997)—were reevaluated to determine if water quality and habitat conditions have improved or worsened over time. To minimize the effects of temporal (seasonal and year to year) variability, sampling was conducted at approximately the same time of the month as the 1988 and 1995 biosurveys. Sampling locations, along with station identification numbers and sampling dates for fish and benthos monitoring, are noted in Table 1. Sampling locations are also shown in Figure 1.

To provide additional information necessary for making basin-wide aquatic life use-support determinations required by Section 305(b) of the Clean Water Act, all Deerfield River watershed macroinvertebrate biomonitoring stations were compared to a regional reference station most representative of the "best attainable" conditions in the watershed. Use of a regional reference station is particularly useful in assessing nonpoint source pollution and nutrient/BOD loadings originating from multiple and/or unknown sources in a watershed, as well as nonpoint source pollution impacts (e.g., physical habitat degradation) at upstream control sites and downstream sites suspected as chemically-impacted from known point source stressors (Hughes 1989). Regional reference stations were established in the Cold River (fourth-order) and Bear River (third-order). Both stations were situated upstream from all known point sources of water pollution, and they were also assumed (based on topographic map examinations and field reconnaissance) to be relatively unimpacted by nonpoint sources. The decision of which reference station to use for comparisons to a study site was based on comparability of stream morphology, flow regimes, and drainage area.

During "year 1" of its "5-year basin cycle", problem areas within the Deerfield River watershed were better defined through such processes as coordination with appropriate groups (EOEA Deerfield River Watershed Team, local watershed associations, DEP/DWM, DEP/WERO), assessing existing data, conducting site visits, and reviewing NPDES and water withdrawal permits. Following these activities, the 2000 biomonitoring plan was more closely focused and the study objectives better defined. Table 2 includes a summary of the perceived problems/issues—both historical and current—addressed during the 2000 Deerfield River watershed biomonitoring survey.

The main objectives of biomonitoring in the Deerfield River watershed were: (a) to determine the biological health of streams within the watershed by conducting assessments based on aquatic macroinvertebrate and fish communities; and (b) to identify problem stream segments so that efforts can be focused on developing NPDES permits, Water Management Act permits, stormwater management, and control of other nonpoint source (NPS) pollution. Specific tasks were:

1. Conduct benthic macroinvertebrate and fish population sampling at locations throughout the Deerfield River watershed;

2. Based upon the macroinvertebrate and fish population data, identify river segments within the watershed with potential point/nonpoint source pollution problems; and

3. Using the benthic macroinvertebrate data, fish population data, and supporting water chemistry (when available) and field/habitat data:

- assess the types of water quality and/or water quantity problems that are present.
- make recommendations for remedial actions.
- provide macroinvertebrate, fish population, and habitat data to DEP/DWM's Environmental Monitoring and Assessment Program for assessments of aquatic life use-support status required by Section 305(b) of the Federal Clean Water Act (CWA).
- provide macroinvertebrate, fish population, and habitat data for other informational needs of Massachusetts regulatory agencies, as well as the Executive Office of Environmental Affairs (EOEA) Massachusetts Watershed Initiative (MWI) Deerfield River Watershed Team.

Table B1. List of biomonitoring stations sampled during the 2000 Deerfield River watershed survey, including station identification number, mile point (distance from confluence with Deerfield River), drainage area, station description, sampling date, and type of sampling (i.e., biota sampled) conducted. Due to limited resources, benthos sampling was not conducted at PH00. Due to equipment constraints, fish sampling was not conducted at GR01, GR02, NOR01, VP11BEA, and LDR01.

Station ID	Mile Point	Drainage Area (mi^2)	**Deerfield River Watershed** Site description	Sampling Date- Biota Sampled
CR01*	0.80	29.72	Cold River, upstream from Trout Brook, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
VP11BEA*	1.70	9.97	Bear River, upstream from Shelburne Falls Road, Conway, MA	27 Sep. 2000- Benthos
PB01	0.25	13.60	Pelham Brook, upstream from Rowe Road, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
DM00	0.10	3.07	Davis Mine Brook, upstream from Mill Brook, Charlemont, MA	25 Sep. 2000- Benthos 27 Sep. 2000- Fish
MB01	1.10	11.16	Mill Brook, downstream from Harris Mtn. Road, Charlemont, MA	25 Sep. 2000- Benthos 27 Sep. 2000- Fish
CH01	0.75	27.07	Chickley River, upstream from Deerfield River, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
NOR01*	0.80	90.51	North River, upstream from Rt. 112, Shattuckville, Colrain, MA	26 Sep. 2000- Benthos
NOR02A*	9.40	50.08	East Branch North River, downstream from Rt. 112, Colrain, MA	26 Sep. 2000- Benthos 27 Sep. 2000- Fish
TB00	0.20	5.16	Taylor Brook, upstream from Heath Road, Colrain, MA	26 Sep. 2000- Benthos 27 Sep. 2000- Fish
SOR01*	2.50	24.12	South River, upstream from Truce Road, at USGS gage, Conway, MA	27 Sep. 2000- Benthos 28 Sep. 2000- Fish
PH00	0.20	1.50	Pumpkin Hollow Brook, upstream from Academy Hall Road, Conway, MA	28 Sep. 2000- Fish
GR01*	0.75	57.42	Green River, downstream from footbridge off Rt. 5-10, Greenfield, MA	27 Sep. 2000- Benthos
GR02*	7.0	20.19	Green River, downstream from Eunice Williams Drive, Greenfield, MA	26 Sep. 2000- Benthos
LDR01*	8.0	374.40	Deerfield River, upstream from Interstate 91, Deerfield, MA	27 Sep. 2000- Benthos

* Macroinvertebrate biomonitoring conducted here by DEP in 1988 and 1995 (Fiorentino 1997).

Table B2. List of perceived problems addressed during the 2000 Deerfield River watershed biomonitoring survey. Specific biomonitoring stations addressing each problem are also listed.

Deerfield River Watershed Station	**Issues/Problems**
Cold River (CR01)*	Potential NPS (road runoff, campground) Reference condition[4]
Bear River (VP11BEA)*	Miscellaneous NPS (road and golf course runoff)[1] Reference condition[4]
Pelham Brook (PB01)	Upstream landfill (uncapped, unlined)[1] Unassessed for aquatic life[2]
Davis Mine Brook (DM00)	Acid mine drainage/pH impairment[1, 3] Habitat alteration[3] Unassessed for aquatic life[2]
Mill Brook (MB01)	Acid mine drainage via Davis Mine Brook[1] Miscellaneous NPS Unassessed for aquatic life[2]
Chickley River (CH01)	Agricultural/livestock runoff[1] Unassessed for aquatic life[2] 303(d)-listed impoundments upstream[3]
North River (NOR01)*	Miscellaneous NPS (agricultural/road runoff, erosion)[1, 3] Industrial discharge upstream, aesthetics (color)[1,2, 3] Recent acid spill upstream[5]
East Branch North River (NOR02A)*	Colrain landfill (uncapped, unlined)[1] Miscellaneous NPS (agricultural/road runoff, yard waste)[1]
Taylor Brook (TB00)	Potential impacts from upstream housing development[1] Road runoff Unassessed for aquatic life[2]
South River (SOR01)*	Miscellaneous NPS (agricultural runoff)[1] Habitat alteration[3]; Sewage treatment (Ashfield) upgrades[6] Potential landfill impacts via Pumpkin Hollow Brook[1]
Pumpkin Hollow Brook (PH00)	Upstream landfill (inactive, unlined)[1] Miscellaneous NPS (agricultural/road runoff)[1] Unassessed for aquatic life[2]
Green River (GR01)*	Urban runoff (stormwater, road runoff)[1,4,6] Illicit sewer connections/dry weather discharges[5] Metals[3]; Habitat degradation[4]
Green River (GR02)*	Miscellaneous NPS (agricultural/road runoff)[1] Unassessed for aquatic life[2]
Deerfield River (LDR01)*	Flow regulation/alteration[4] Unknown NPS impacts Upstream point source discharges[4]

* Macroinvertebrate biomonitoring conducted here by DEP in 1988 and 1995 (Fiorentino 1997)

[1] (EOEA 1999)

[2] (MA DEP 2000)

[3] (MA DEP 1999)

[4] (Fiorentino 1997)

[5] (Duerring, EOEA Deerfield River Watershed Team, personal communication)

[6] (MA DEP 1997)

DEERFIELD RIVER WATERSHED
BIOMONITORING STATIONS

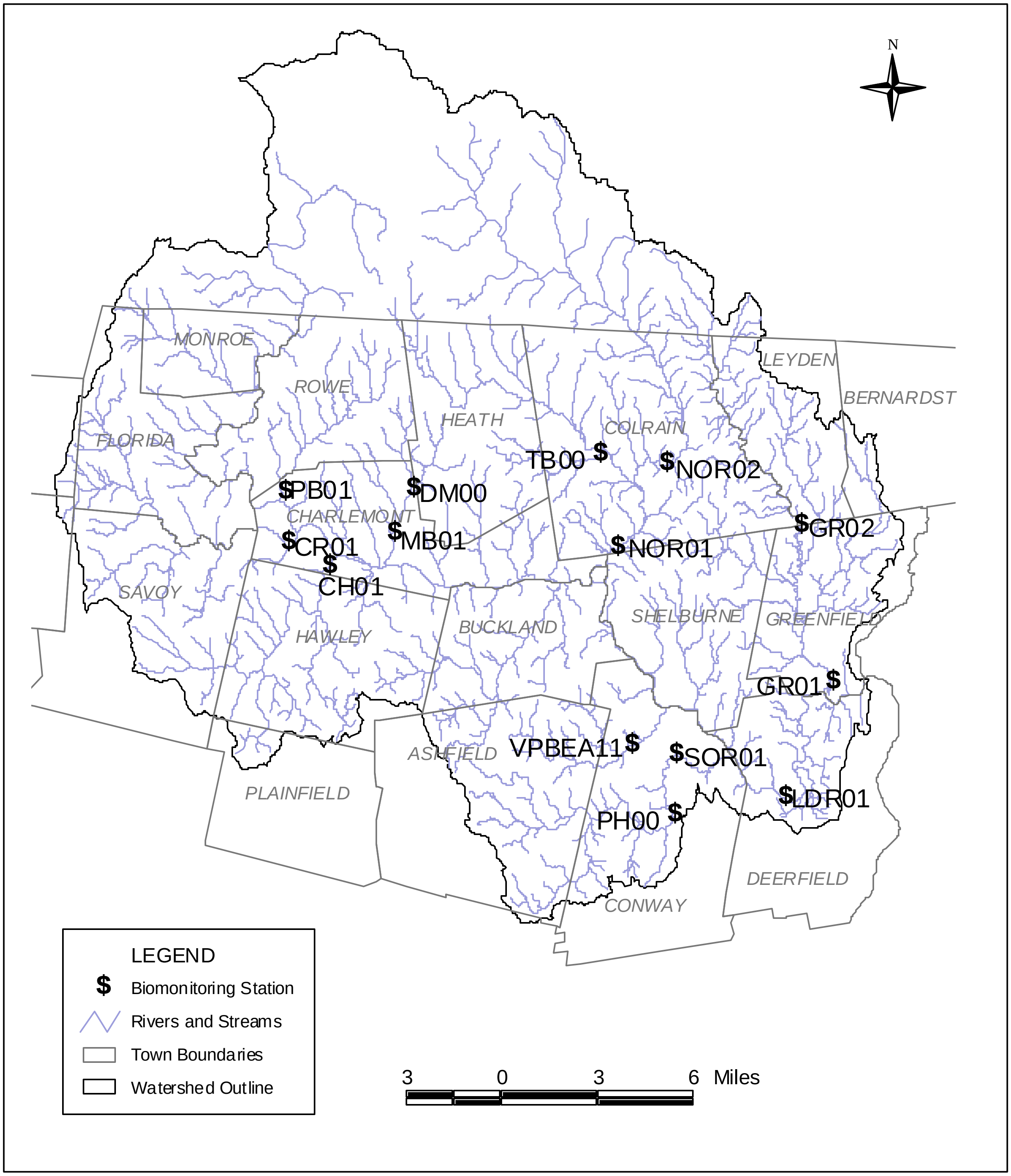

Figure B1. Location of DEP/DWM biomonitoring stations for the 2000 Deerfield River watershed survey.

METHODS

Macroinvertebrate Sampling - RBPIII

The macroinvertebrate sampling and processing procedures employed during the 2000 Deerfield River watershed biomonitoring survey are described in the standard operating procedures (Nuzzo 1999a), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream (Figure 2). Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Sampling was conducted by DEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the DEP/DWM lab for further processing.

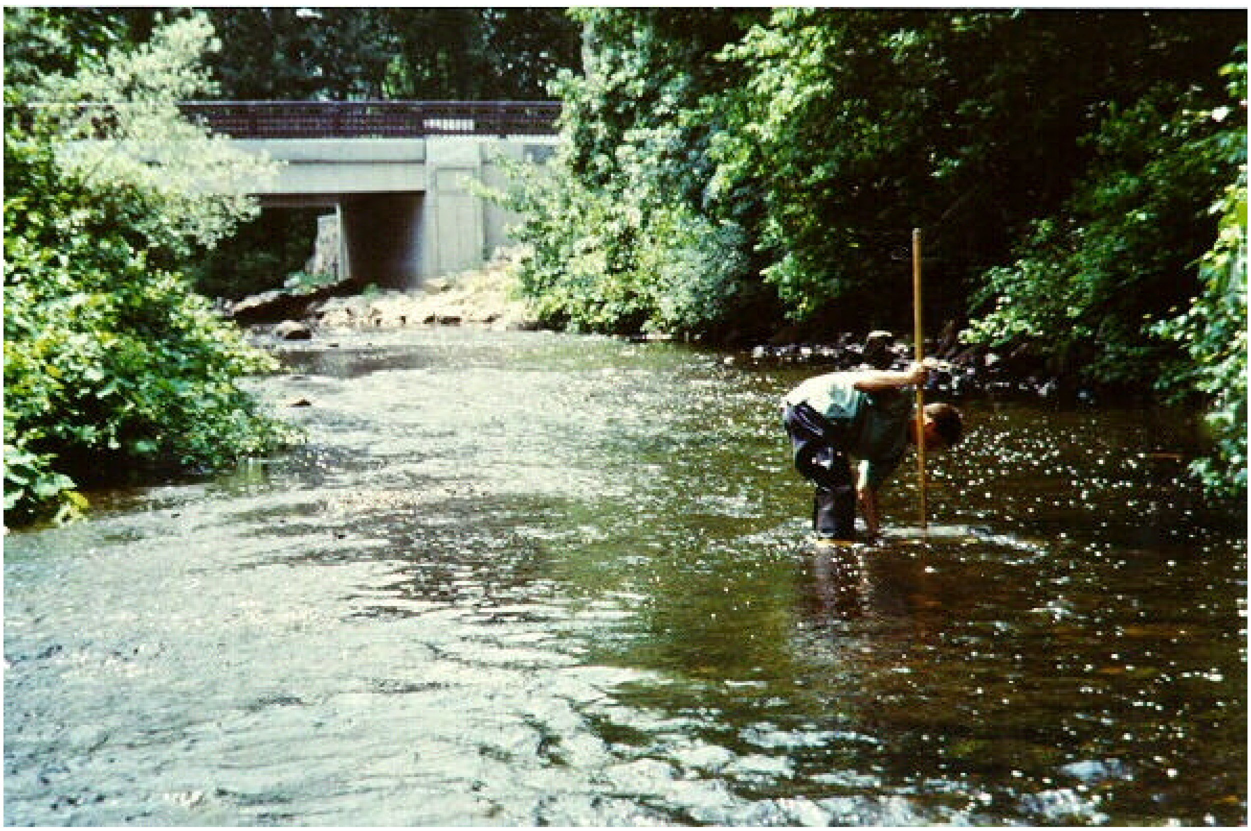

Figure B2. MA DEP/DWM biologist collecting macroinvertebrates using the “kick-sampling” technique.

Fish Population Sampling

The fish sampling and processing procedures employed during the 2000 Deerfield River watershed biomonitoring survey are described in Method 003/11.20.95 Fish Collection Procedures (MA DEP 2002b), and are similar to Rapid Bioassement Protocol V (RBPV) as described originally by Plafkin (1989) and later Barbour et al. (1999). Sampling activities also included a habitat assessment component modified from that described in the aforementioned document.

Fish populations were sampled by electrofishing using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 80 m and 100 m in length was sampled by passing a pole-mounted anode ring nside to side through the stream channel and in and around likely fish cover. All fish fished were netted and held in buckets. Sampling proceeded from an obstruction or constriction at the downstream end of the reach to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle at the upstream end of the reach. Following completion of a sampling run, all fish were identified to species, measured, weighed, and released.

Macroinvertebrate Sample Processing and Analysis

Macroinvertebrate sample processing entailed distributing whole samples in pans, selecting grids within the pans at random, and sorting specimens from the other materials in the sample until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity. Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Barbour et al. 1999). Based on the taxonomy, various community, population, and functional parameters, or “metrics”, were calculated which allow measurement of important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Barbour et al. 1999). Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for a selected “least-impacted” reference station yields an impairment score for each site. RBP III analysis separates sites into four categories: non-impacted, slightly impacted, moderately impacted, and severely impacted. Each impact category corresponds to a specific aquatic life use-support determination used in the CWA Section 305(b) water quality reporting process—non-impacted communities are assessed as “support” in the 305(b) report, slightly impacted communities are assessed as “partial support”, moderately and severely impacted communities are assessed as “non support.” A detailed description of the *Aquatic Life* use designation is outlined in the *Massachusetts Surface Water Quality Standards* (MA DEP 1996). Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Barbour et al. 1999). Those biological metrics calculated and used in the analysis of Deerfield River watershed macroinvertebrate data are listed and defined below [For a more detailed description of metrics used to evaluate benthos data see Barbour et al. (1999)]:

1. Taxa Richness—a measure based on the number of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability. The lowest possible taxonomic level is assumed to be genus or species.

2. EPT Index—a count of the number of genera/species from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). As a group these are considered three of the more sensitive aquatic insect orders. Therefore, the greater the contribution to total richness from these three orders, the healthier the community.

3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution (Hilsenhoff 1982). Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. Tolerance values currently used by DEP/DWM biologists were originally developed by Hilsenhoff and have since been supplemented by Bode et al. (1991) and Lenat (1993). A value of zero indicates the taxon is highly

intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

$$HBI = \sum \frac{x_i t_i}{n}$$

where
xi = number of individuals within a taxon
ti = tolerance value of a taxon
n = total number of organisms in the sample

4. Ratio of EPT and Chironomidae Abundance—The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Skewed populations having a disproportionate number of the generally tolerant Chironomidae ("midges") relative to the more sensitive insect groups may indicate environmental stress.

5. Percent Contribution Dominant Taxon—is the percent contribution of the numerically dominant taxon (genus or species) to the total numbers of organisms. A community dominated by few species indicates environmental stress. Conversely, more balance among species indicates a healthier community.

6. Ratio of Scraper and Filtering Collector Functional Feeding Groups—This ratio reflects the community food base. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (Barbour et al. 1999). Scrapers predominate when diatoms are the dominant food resource, and decrease in abundance when filamentous algae and mosses prevail. Filtering collectors thrive where filamentous algae and mosses are prevalent and where fine particulate organic matter (FPOM) levels are high.

7. Community Similarity—is a comparison of a study site community to a reference site community. Similarity is often based on indices that compare community composition. Most Community Similarity indices stress richness and/or richness and abundance. Generally speaking, communities with comparable habitat will become more dissimilar as stress increases. In the case of the Deerfield River watershed bioassessment, an index of macroinvertebrate community composition was calculated based on similarity (i.e., affinity) to the reference community, expressed as percent composition of the following organism groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Chironomidae, and Other. This approach is based on a modification of the Percent Model Affinity (Novak and Bode 1992). The reference site affinity (RSA) metric is calculated as:

   $$100 - (\Sigma\ \delta \times 0.5)$$

   where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBPIII scores as follows: <35% receives 0 points; 2 points in the range from 35 to 49%; 4 points for 50 to 64%; and 6 points for ≥65%.

Fish Sample Processing and Analysis

The RBP V protocol (Plafkin et al. 1989; Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI exists for Massachusetts' surface waters, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification – Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Meixler (2000) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.

3. Trophic Classes – Classification that utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al. (1999).

Habitat Assessment

An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2000 Deerfield River watershed biosurveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and the immediate riverfront area. Most parameters evaluated are instream physical attributes often related to overall land-use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a reference station to provide a final habitat ranking.

RESULTS AND DISCUSSION

The biological and habitat data collected at each sampling station during the 2000 biosurveys are attached as an Appendix (Tables A1 – A5). Fish population data were collected at eight of the thirteen stations where macroinvertebrates were collected and at one additional station not sampled for macroinvertebrates. Included in the macroinvertebrate and fish taxa lists (Table A1 and A5) are total organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, the habitat and trophic class for each fish taxon, and the tolerance value (TV) of each taxon (macroinvertebrates and fish).

Summary tables of the RBP III macroinvertebrate data analyses, including biological metric calculations, metric scores, and impairment designations, are included in the Appendix as well. Table A2 is the summary table for those biomonitoring stations that used the Cold River (CR01) as the regional reference station. Table A3 is the summary table for station comparisons to the Bear River reference site (VP11BEA). Habitat assessment scores for each station are also included in the summary tables, while a more detailed summary of habitat parameters is shown in Table A4.

The 2000 biomonitoring data for the Deerfield River watershed generally indicate good overall water quality and biological health at most of the stations investigated. Impairment of resident biota was most severe at the Davis Mine Brook station (DM00), where suspected toxic effects resulting from acid mine drainage were evident and appear to persist farther downstream in Mill Brook (MB01). Other anthropogenic perturbations affecting biological integrity were detected in the Chickley (CH01) and East Branch North (NOR02A) rivers, where the presumed effects of organic enrichment probably related to agricultural/livestock runoff resulted in impacts to the aquatic community. The non-impacted benthic communities observed at stations in the South (SOR01) and Green (GR01) rivers were encouraging, as these stations were clearly impacted by nonpoint source pollution during DEP's 1995 Deerfield River watershed survey (Fiorentino 1997). Reference-quality biomonitoring stations in the Bear (VPBEA11) and Cold (CR01) rivers continue to support diverse and well-balanced aquatic communities expected in a "least-impacted" stream system.

Deerfield River Watershed

The Deerfield River, a tributary to the Connecticut River, drains 663 square miles of northwestern Massachusetts and south central Vermont. More than one-half of the Deerfield River watershed, 347 square miles, is in Massachusetts and includes most of Franklin County and parts of Berkshire and Hampshire Counties. The beginning of the Deerfield River in Massachusetts is at the Vermont-Massachusetts border, which intersects the Sherman Reservoir on the Massachusetts side at Monroe and Rowe. It then flows 44 miles to its confluence with the Connecticut River.

Most of the Deerfield River watershed drainage area is in the Berkshire Hills physiographic province where the topography consists of narrow river valleys bordered by steep hill slopes. The southeastern part of the watershed is part of the Connecticut Valley Lowlands physiographic province where the topography is flatter than the Berkshire Hills. Land surface altitudes in the watershed range from 120 feet above sea level in the Connecticut Valley Lowlands to 2,841 feet above sea level in the Berkshire Hills. Average annual precipitation ranges from 44 inches in the low altitudes of the southeast to 50 inches in the high altitudes in the western part of the watershed.

The watershed is bordered in Massachusetts by the Hoosic, Westfield, and Connecticut River watersheds. Major tributaries to the Deerfield River, in order of decreasing drainage area are: the North River (92.9 square miles), the Green River (89.8 square miles), the Cold River (31.7 square miles), the Chickley River (27.4 square miles), the South River (26.3 square miles), and Clesson Brook (21.2 square miles).

The watershed area covers all or a part of twenty municipalities: Heath, Monroe, Florida, Savoy, Rowe, Charlemont, Hawley, Colrain, Buckland, Plainfield, Ashfield, Conway, Shelburne, Leyden, Bernardston, Greenfield, Deerfield, Goshen, North Adams, and Adams. In 1990, the population in this rural watershed was about 35,300, with more than 50 percent of the population in the City of Greenfield (18,666 people) in the Connecticut Valley lowlands. Land-use in the watershed consists of forest (81%), agriculture and open land (13%), urban development (4%) and surface water (2%).

The steep gradient of the Deerfield River has been extensively utilized in the production of hydroelectric power. Seven hydroelectic dams regulate flows along the mainstem Deerfield River in Massachusetts, although these provide only a small amount of the stored water used to generate electricity. Most of the water used to operate the generating stations is stored in reservoirs on the headwaters of the Deerfield River in Vermont. Balancing hydroelectric power generation with other uses such as recreational and ecological has resulted in a newly negotiated Federal Regulatory Energy Commission (FERC) relicensing agreement between power companies and the States of Massachusetts and Vermont and the Deerfield Compact, an *ad hoc* group representing local interests.

There are currently seven permitted NPDES discharges in the Deerfield River watershed, including the non-contact cooling water permit for the Yankee Atomic Electric Company. The largest is the Greenfield wastewater treatment plant, which is being renovated. Among the renovations is the relocation of the discharge point from the Green River to the Deerfield River. The downtown section of Ashfield has been sewered and the sewage is being treated in a newly-built Solar Aquatics alternative wastewater treatment facility, which discharges to the groundwater.

Water released from the dams affects the entire range of stream flow and causes mulitple daily stream stage fluctuations. The river gradient averages 28.4ft/mi from the Vermont border to the streamflow-gaging station at West Deerfield, a distance of about 33 river miles. The United States Geological Survey (USGS) currently maintains five flow monitoring stations in the Massachusetts portion of the watershed; two of these on the mainstem Deerfield River. The other three are located on the North, South and Green Rivers. Flow information recorded at each USGS gaging station during the 2000 DEP/DWM biomonitoring survey period (25 to 28 September) is available online (USGS 2002), and can be found in Table 3.

Table B3. Flow data (stream discharge) recorded at each of five USGS flow-gaging stations in the Deerfield River watershed during the 2000 biomonitoring survey from 25 to 28 September. Data are available online (USGS 2002).

Gaging Station	Gage Location	Date (2000)	Daily Mean Stream Flow (cubic feet/sec)
01168500	Deerfield River, at Charlemont, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	220 250 325 273
01170000	Deerfield River, near West Deerfield village, Deerfield, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	452 417 476 449
01169000	North River, at Shattuckville village, Colrain, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	100 84 81 74
01169900	South River, near Conway, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	22 21 26 21
01170100	Green River, near Colrain, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	46 39 37 33

Cold River

From its headwaters near Florida State Forest and just upstream from Blackstone Road in Florida, the Cold River flows in a generally southeasterly direction before joining the mainstem Deerfield River in Charlemont. The minimally developed Cold River subwatershed drains numerous tributaries and small ponds, many of which lie within Savoy Mountain and Mohawk Trail State forests. The steep gradient of much of this fourth-order river and its tributaries provides dramatic scenery and offers excellent recreational opportunities, especially fishing, hiking, and kayaking.

CR01—Cold River, mile point 0.80, upstream from Trout Brook, 250 m downstream from entrance to Mohawk Trail State Forest campground, Charlemont, MA.

Habitat

The CR01 sampling reach began approximately 250 m downstream from the access road to the Mohawk Trail State Forest campground. Almost completely open-canopied, the reach was approximately 14 m wide, with a relatively uniform depth of 0.40 m throughout much of its riffle-dominated length. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Rocky substrates, subjected to swift current velocity, provided excellent riffle habitat for epifaunal macroinvertebrates. In addition, large boulders provided stable cover and good fish habitat throughout the reach (though pool habitat was somewhat limited). Instream vegetation was absent; however, a thin coating of filamentous green algae covered much of the substrates. Riparian and bank parameters generally scored well. Banks were well-vegetated with shrubs (witch-hazel, *Hamamelis virginiana*) and herbaceous (ferns and mosses) growth before giving way to a forest-dominated (alder, *Alnus* sp.; hemlock, *Tsuga canadensis*; maple, *Acer* spp.) riparian zone. Riparian growth was undisturbed along the right (west) bank, while a dirt road/path resulted in minor disturbance near the left (east) bank.

Nonpoint source pollution was not evident in the sampling reach; however, runoff from the upstream campground and small footpaths (probably used by fishermen) adjacent to the reach offered potential inputs. In addition, the road (Route 2) adjacent to this portion of the Cold River—while adequately buffered from the CR01 reach—may be a potential source of road salt and sediment inputs farther upstream, especially where it crosses the river.

CR01 received a composite habitat score of 178/200—one of the higher habitat evaluations received by a biomonitoring station in the Deerfield River watershed (Table A4). This was used as the primary reference station for comparisons to biomonitoring stations in the mainstem Deerfield River (LDR01), North River (NOR01, NOR02A), Chickley River (CH01), South River (SOR01), and Green River (GR01, GR02)—all of which are predominately open-canopied reaches with comparable flow regimes, instream habitat, and upstream drainage areas. Designation of CR01 as a reference condition was based on its high habitat evaluation, historically good water quality (MA DEQE 1979; MA DEP 1989; MA DEP 1997), minimal NPS pollution inputs, and minimal upstream/adjacent land-use impacts (i.e., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well-vegetated riparian zone).

Benthos

The Cold River biomonitoring station was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions (Table A2). In particular, those attributes that measure components of community structure (i.e., Taxa Richness, Biotic Index, EPT Index)—which display the lowest inherent variability among the RBP metrics used (Resh 1988)—scored well, further corroborating the designation as a reference station. An extremely low Biotic Index (3.48—one of the lowest of all the Deerfield River watershed biomonitoring stations), a high (second highest value in the survey) EPT Index, and low dominance of a single taxon relative to other biomonitoring stations in the survey indicated a dominance of pollution-sensitive taxa among the CR01 benthos assemblage, and good overall community balance. And while chironomids were fairly well represented here, the dominant midge taxon, *Polypedilum aviceps*, is considered a "clean water" indicator—assigned a low tolerance value and rarely associated with impacted waters (Bode and Novak 1998). The CR01 benthic community received a total metric score of 42 out of a possible score of 42 (Table A2).

Fish

Fish sampling efficiency at CR01 was rated poor. This was mostly due to the width of the stream and the presence of extensive riffle/run type habitat. It was difficult to keep fish ahead of the electrical field—many fish were seen escaping downstream and to the sides of the electrofishing crew. Fish species captured, in order of abundance, included Atlantic salmon (*Salmo salar*), blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*), and brown trout (*Salmo trutta*) (Table A5). The presence of three intolerants, as well as two-year classes of Atlantic salmon, is indicative of excellent water and habitat quality. It is unclear as to what effect, if any, the stocking of Atlantic salmon fry and the presence of brown trout may be having on brook trout, which were not collected within this reach.

Bear River

The headwaters of this third-order stream begin in Ashfield just east of Ridge Hill. The newly formed river flows through a golf course where it is impounded and then continues in a southeasterly direction until it passes into Conway. There it changes direction, flowing to the northeast and receiving the drainages of Sids and Drakes brooks. After passing under Shelburne Falls Road, the river enters a very steep valley before its confluence with the Deerfield River in Conway. With the exception of the golf course and a few sand/gravel pits, the Bear River subwatershed is relatively undisturbed and forested, with minimal residential development.

VP11BEA—Bear River, mile point 1.70, 100 m upstream from Shelburne Falls Road, Conway, MA.

Habitat

The VP11BEA sampling reach began approximately 100 m upstream from Shelburne Falls Road and meandered through a hemlock (*Tsuga canadensis*) and red maple (*Acer rubrum*) dominated forest that provided a mostly (>75%) closed canopy. This portion of the stream was approximately 10 m wide, ranging in depth from 0.30 m in the riffles to 0.50 m in the deepest pool areas. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Well-developed riffle areas with a variety of stable hard substrates (boulder/cobble, submerged logs) offered exceptional habitat for fish, and especially, macroinvertebrates. Dense bryophyte cover on much of the rock substrates provided additional productive microhabitat for macroinvertebrates. Thin layers of periphyton covered substrates in almost half of the sampling reach. Embeddedness and sediment deposition were virtually nonexistent. Bank stability was excellent along the well-vegetated (ferns and mosses) left (west) bank, while the steepness of the right (east) bank led to small areas of sloughing (i.e., "healed-over" bank). The majority of the east bank was stabilized with massive boulders and large tree roots. The dense forest along the west side of the stream provided an unlimited and undisturbed riparian vegetative zone throughout the reach. And despite the close proximity of Shelburne Falls Road, the east bank's riparian zone was well-buffered with shrubs (mountain laurel, *Kalmia latifolia*; witchhazel, *Hamamelis virginiana*) and tree growth. There were no signs of nonpoint source pollution in the immediate area.

VP11BEA received a composite habitat score of 176/200 (Table A4). This was used as the primary reference station for comparisons to biomonitoring stations in Mill Brook (MB01), Davis Mine Brook (DM00), Taylor Brook (TB00), Pelham Brook (PB01), and Pumpkin Hollow Brook (PH00, habitat comparisons only)—all of which are mostly closed-canopied reaches with comparable flow regimes, instream habitat, and drainage area. In addition, VP11BEA was used as a secondary reference station for CH01 and SOR01—stations within larger drainage areas, yet comparable to the Bear River in terms of stream order. Designation of VP11BEA as a reference condition was based on its high habitat evaluation, historically good water quality (MA DEQE 1979; MA DEP 1997), minimal nonpoint source pollution inputs, and minimal upstream/adjacent land-use impacts (i.e., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well-vegetated riparian zone).

Benthos

VP11BEA was characterized by a diverse, taxa-rich (taxa richness=31) assemblage that included a number of highly intolerant EPT taxa (Table A3). In fact, the Plecoptera, generally considered the most pollution-sensitive insect order, was represented by four families among the VP11BEA biota. The Ephemeroptera, another sensitive insect order, was also well represented and included the numerically dominant taxon *Rithrogena* sp., which has a tolerance value of zero and requires well-oxygenated water. In general, the benthic community here was well-balanced—a Percent Dominant Taxon of 12% was very low relative to the other tributary stations in the survey—with all major trophic groups represented.

VP11BEA received a total metric score of 42 (Table A3). The optimum community and trophic structure exhibited in the macroinvertebrate assemblage here suggest that this portion of the Bear River is indeed indicative of the "best-attainable" conditions in the Deerfield River watershed.

Pelham Brook

Pelham Brook originates in the hills of northern Rowe, flowing southward into Pelham Lake. From the outlet of Pelham Lake the stream continues in a southwesterly direction, receiving the drainages from several first-order tributaries before joining the Deerfield River just upstream from the Cold River. Land-use throughout much of the Pelham Brook subwatershed consists of relatively undeveloped forest or light residential development. Pelham Lake and its shoreline are used for recreational activities. The Town of Rowe maintains an active (uncapped, unlined) landfill located on Zoar Road and in close proximity to Pelham Brook (EOEA 1999).

PB01—Pelham Brook, mile point 0.25, 200 m upstream from Rowe Road, Charlemont, MA.

Habitat

PB01 began approximately 200 m upstream from Rowe Road in a mostly forested area of hemlocks (*Tsuga canadensis*) and various hardwoods (birch, *Betula* spp.; maple, *Acer* spp.; alder, *Alnus rugosa*), and some light residential development. The 7 m wide sampling reach was dominated by fast water (i.e., riffles) ranging in depth from 0.25 – 0.50 m, with occasional pools as deep as 0.75 m. A variety of rocky substrates—especially boulder and large cobble—and varying velocity-depth combinations provided excellent benthic habitat for macroinvertebrates. Fish habitat was also optimal, with boulders and submerged woody material in both riffles and deep pools providing ample cover throughout the mostly (60%) shaded reach. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Instream vegetation and algae were absent. Both stream banks were stabilized with large boulders (naturally occurring, not "rip-rap") along the entire length of the sampling reach. Banks were well-vegetated with herbaceous (ferns and mosses) growth before giving way to the densely forested riparian zone.

Two single-family homes were situated adjacent to the stream near the top and bottom of the reach; however, trees provided an adequate riparian buffer between the stream channel and the homes. No other potential sources of nonpoint pollution were observed.

PB01 received a total habitat assessment score of 187/200, which was higher than most of the Deerfield River watershed biomonitoring stations, including both the Bear River and Cold River references stations (Table A4). The riparian zone along the left bank, which was somewhat reduced due to the adjacent residences, was the only habitat parameter scoring less than optimal.

Benthos

The PB01 benthic community received a total metric score of 38, representing 90% comparability to reference conditions at VP11BEA and resulting in a biological assessment of "non-impacted" (Table A3). Although total taxa richness was slightly reduced compared to the VP11BEA assemblage, richness of the pollution sensitive EPT taxa was equal to that of the reference station. And the Biotic Index here was actually lower than the reference community, due in large part to the abundance of the highly sensitive (TV=0) perlodid stonefly, *Sweltsa* sp. The EPT/Chironomidae and Scrapers/Filterers metrics also performed better than the benthic community observed at VP11BEA—in fact, an EPT/Chironomidae metric value of 7.36 was the highest of all the biomonitoring stations in the 2000 survey and suggests good community balance.

Based on the biological assessment of the macroinvertebrate community encountered at PB01, it appears that water quality effects related to the upstream landfill and/or impoundment are absent or imperceptible here. The resident benthos, instead, appear to reflect the diverse and high quality habitat afforded them in this portion of Pelham Brook.

Fish

Fish sampling efficiency at PB01 was rated excellent. Fish species captured in order of abundance included slimy sculpin (*Cottus cognatus*), longnose dace, Atlantic salmon, brook trout (*Salvelinus fontinalis*,), blacknose dace, and brown trout (Table A5). The presence of five intolerants, two-year classes of Atlantic salmon, and the dominance of slimy sculpin are indicative of excellent water and habitat quality. It is possible and likely that the stocking of Atlantic salmon fry is having a negative effect on the number of brook trout present; however, at the present time the large amount of instream fish cover in the form of boulders may provide enough habitat for both species. Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable.

Mill Brook/Davis Mine Brook

A third-order stream, Mill Brook originates in western Heath near the Rowe border. The stream flows in a southerly direction, joining the mainstem Deerfield River in Charlemont center just downstream from Route 2. Along its course, major discharge contributions come from Maxwell and Davis Mine brooks. The Mill Brook subwatershed is mostly forested, with some light residential development mainly located along Route 8A and additional commercial activity near its mouth in downtown Charlemont. Davis Mine Brook has historically received the acid drainage of the now-defunct Davis Mine, which was an important source of iron pyrite (used for the manufacturing of sulfuric acid) during the late nineteenth century (Franklin County 2002).

DM00—Davis Mine Brook, mile point 0.10, 200 m upstream from Mill Brook, Charlemont, MA.

Habitat

The sampling reach in this extremely high-gradient second-order stream began almost immediately upstream from its confluence with Mill Brook in a densely forested portion of the subwatershed. A series of cascades and plunge pools, the partially (50%) shaded stream was approximately 4 m wide, with depths of 0.10 – 0.50 m in the riffles and pools about 0.50 m deep. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Boulder and cobble substrates provided excellent macroinvertebrate habitat in the riffle areas, while a variety of submerged woody materials (snags and submerged logs) provided potential instream fish cover throughout the reach. Instream vegetation was minimal and consisted mainly of mosses, while occasional mats of green and brown algae were observed in both pool and riffle areas. Much of the hard instream substrates—especially cobble, gravel, and sand—appeared reddish in color, probably the result of ferric inputs from upstream mining activities. Both stream banks were well-vegetated with herbaceous (ferns and mosses) and shrubby growth, and stability was good despite the steep nature of the embankment. Riparian growth was undisturbed along the right (west) bank, consisting of a dense evergreen/deciduous forest dominated by hemlock (*Tsuga* sp.), birch (*Betula* sp.), beech (*Fagus* sp.), and red maple (*Acer rubrum*). Riparian vegetative growth was greatly disrupted along the left (east) bank, however, due to an encroaching residential property. Nonpoint source pollution associated with this property poses a serious threat to this portion of Davis Mine Brook, as it serves as a "junkyard" for numerous cars and trucks (including school buses), auto-parts, appliances, and other forms of scrap metal and debris. The early-model automobiles observed here suggest dumping has occurred at this site over the course of several years—possibly decades.

DM00 received a total habitat assessment score of 174/200 (Table A4). The extremely reduced riparian vegetative zone width along the east bank affected the total score most negatively.

Benthos

Most striking at DM00 was the low diversity and depauperate nature of the resident benthos assemblage. In fact, even after spending an inordinate (i.e., several hours) amount of time "picking" the DM00 benthos sample, it was impossible to attain a 100-organism subsample from the original sample due to the extremely low densities of organisms present. As a result of the small subsample size, direct metric comparisons to the reference community were not appropriate. Even without conducting a RBPIII analysis of the DM00 community, however, the macroinvertebrate assemblage encountered here clearly reflects the effects of severe environmental stress and possibly toxic impacts.

Water quality impacts to Davis Mine Brook—specifically low pH values—related to the acid-mine drainage of Davis Mine have historically been documented by DEP (MA DEP 1997, 1999, and 2000). Hall et al. (1980) suggest that acidification affects aquatic organisms in the following ways: (1) directly through changes in physiology; (2) indirectly by the increase of trace metal concentrations that may be toxic to many organisms—often resulting in reduced total abundance and species richness; and (3) indirectly through food availability, that is, by reduced primary production and/or reduced bacterial decomposition.

The impoverished (i.e., low species richness and abundance) nature of the DM00 biota appears typical of aquatic communities residing in the receiving waters of acid mine runoff (or airborn acidification for that matter) (Wiederholm 1984). In addition, other aspects of the trophic and community structure of the macroinvertebrate assemblage are consistent with past studies of acidified streams. Scrapers and filter-feeders, usually very common in virtually all types of lotic stream systems of varying water quality, were conspicuously absent from the DM00 sample. According to Smith et al. (1990), these functional groups are more susceptible to the effects of acidification than other groups such as shredders which comprised almost half of the DM00 subsample (Table A1). This may be, in part, the result of acid-induced reductions in organic food resources normally made available through primary production and bacterial decomposition of plant/algal matter. Also noticeably absent were the Ephemeroptera (mayflies), an insect group known to be highly sensitive to acidification (Johnson et al. 1993).

Although mining activities associated with the Davis Mine were terminated in the early 1900s, the effects of mining appear to linger in this portion of the Davis Mine Brook/Mill Brook subwatershed. The persistence of specific or cumulative acid-mine impacts—most notably, low pH, high concentrations of heavy metals, and ferric hydroxide precipitation—will undoubtably continue to be reflected in the aquatic community of Davis Mine Brook for many more years. In fact, studies suggest that the complete recovery of macroinvertebrate communities in areas affected by acid-mine drainage may require several decades (Wiederholm 1984).

Fish

Despite very stable fish habitat in the form of boulders, cobble, and submerged woody materials (snags and submerged logs), not a single fish was captured or observed in Davis Mine Brook. It appears, then, that the severe water quality problems originating from Davis Mine and reflected in the macroinvertebrate community here have impacted the fish populations as well—completely eliminating them from this stream. In light of the fact that Davis Mine Brook may be causing negative impacts to the Mill River, restoration of this stream should be a Deerfield River watershed priority.

MB01—Mill Brook, mile point 1.10, 500 m downstream from Harris Mountain Road (adjacent to Route 8A), Charlemont, MA

Habitat

Station MB01 began approximately 500 m downstream from Harris Mountain Road in Charlemont and closely paralleled Route 8A. The mostly (70%) shaded reach was approximately 8 m wide and dominated by fast water, with riffle areas ranging in depth from 0.10 – 0.50 m. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. An abundance of boulder and cobble substrates offered excellent epifaunal habitat for benthic macroinvertebrates, while deep (0.50 – 0.75 m) pools containing boulders and fallen trees provided excellent cover and habitat for fish. With the exception of some instream mosses, aquatic vegetation was absent, as was algal growth. Both stream banks were well-vegetated with ferns, mosses and trees before giving way to a forested riparian zone dominated by evergreens (hemlock, *Tsuga canadensis*; white pine, *Pinus strobus*) and occasional birches (*Betula* spp.). Banks were moderately unstable, with 30-60% of the steep embankments in the sampling reach exhibiting areas of erosion. There were no signs of nonpoint source pollution in the reach. And despite the close proximity of the adjacent road (Route 8A) near the right (west) bank, it was well buffered with riparian vegetation.

MB01 received a total habitat assessment score of 181/200, which was higher than most of the Deerfield River watershed biomonitoring stations, including both the Bear River and Cold River reference stations (Table A4). Only the habitat parameter for bank stability scored less than optimal. Observed areas of bank instability and erosion appeared to be naturally occurring—probably the result of high spring flows and exacerbated by the steepness of the banks.

Benthos

Despite the high-quality habitat available, the MB01 macroinvertebrate community received a biological assessment of "slightly impacted". A total metric score of 30 was 71% comparable to the reference community in the Bear River (Table A3). Metrics for Taxa Richness, EPT/Chironomidae, and Percent Dominant Taxon all performed worse than the reference station. Most pronounced were point reductions for the EPT Index metric, the lowest value (10)—with the exception of DM00—of all the biomonitoring stations in the Deerfield River watershed survey. Interestingly, taxa most sensitive to organic pollutants—most notably plecopterans such as *Sweltsa* sp (TV=0; 25 individuals recorded in sample), were well-represented and contributed to a low Biotic Index (3.49). This suggests that water quality perturbations other than organic/nutrient loadings may compromise biological integrity in this portion of Mill Brook. The abundance (n=17) of the chironomid *Eukiefferiella claripennis* gr. in the MB01 benthos sample may be significant, as this taxon has been associated with toxic wastes (Bode and Novak 1998). As the MB01 biomonitoring station is only about 2 km downstream from the Davis Mine brook confluence, it is possible that the effects of the acid mine drainage observed at DM00 continue to persist here as well—though not to the extent seen at Davis Mine Brook where the dilution capacity is probably considerably less than in this portion of Mill Brook. That taxa most vulnerable to acidified conditions (e.g., scrapers, mayflies) are well represented at MB01 corroborates the improved water quality conditions here compared to the degradation observed upstream at Davis Mine Brook. And while the acid-mine drainage originating from Davis Mine Brook is one obvious potential source of water quality impacts, other stressors may exist as well. Already mentioned as a threat to water quality and biological potential is the dumping occurring near the mouth of Davis Mine Brook. And while much of the upper portion of the Mill Brook subwatershed is relatively undeveloped, other potential sources of anthropogenic perturbation may exist as well.

As water quality, rather than habitat quality, appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be instrumental in determining the specific types of water quality degradation present here.

Fish

Fish sampling efficiency at MB01 was rated as good (70% pickup). The sampling reach included stable habitat for fish in the form of boulders, rocky runs, and isolated pools; however, there was very little habitat in the slow/deep category. Fish species captured in order of abundance included Atlantic salmon, brook trout, and blacknose dace (Table A5). Overall numbers were relatively low with a total of 55 fish being collected. Although three of the species collected are classified as intolerant, the low numbers and absence of slimy sculpin and longnose dace should be noted. Two-year classes of Atlantic salmon dominated the fish community with brook trout outnumbered almost 2.5 to 1. Salmon and brook trout may be competing for a limited amount of space. In addition, the inflow of Davis Mine Brook located just upstream from this station may be contributing to fish community impacts (e.g., low densities) at MB01.

Chickley River

The Chickley River originates just south of Borden Mountain in Savoy Mountain State Forest. A third/fourth-order stream, it receives the drainage of several small tributaries as it flows eastward into Hawley and Kenneth Dubuque State Forest. After receiving considerable discharge contributions here from Fuller, King, and Basin brooks, the river veers north along Route 8A. After its confluence with Mill Brook, the river continues north until it joins the mainstem of the Deerfield River in Charlemont. Much of the Chickley River subwatershed is extensively forested and undeveloped. Residential development is light and mainly confined to the Route 8A corridor. Numerous small farms are located along the river—agricultural activity is most common in the Hawley portion of the subwatershed. Agricultural runoff from livestock has historically contributed to water quality degradation in the Chickley River near its mouth (MA DEP 1997; MA DEP 1999). The EOEA Deerfield River Watershed Team has been working with local farmers and conservation commissions to address this problem (EOEA 1999). Some grant-funded BMP implementation has occurred in the lower portion of the Chickley River since the last DEP/DWM water quality survey conducted in 1995.

CH01—Chickley River, mile point 0.75, 900 m upstream from confluence with Deerfield River, Charlemont, MA.

Habitat

Near the mouth of the Chickley River, the sampling reach began immediately upstream from a driveway crossing located just off Route 8A in Charlemont. The 12 m-wide open-canopied (<5% shaded) reach meandered through an area densely forested along the left (west) bank and with some field/pasture near the right (east) bank. Riffle areas dominated the reach, including deep (0.90 m) rapids where bedrock slabs constricted channel width. Rocky substrates subjected to varying (0.10 – 0.90 m) depths of swift water, provided excellent instream macroinvertebrate habitat throughout much of the station, though the marginal channel flow status (channel <75% full) resulted in a fair amount of exposed epifaunal substrates along the margins of the stream. Fish habitat was also good, with boulders and bedrock ledges providing the majority of the cover. Aquatic vegetation was absent and algal growth was minimal, consisting mainly of small patches of filamentous green forms on rock substrates. Both banks were well-vegetated with ferns, mosses, and herbaceous (including Japanese knotweed, *Polygonum cuspidatum*) growth. The steep nature of the banks, however, led to small erosional areas along the west bank and more severe instability along the east bank. Riparian vegetation was well-established along both banks, and was especially extensive along the forested (hemlock, *Tsuga canadensis*; American beech, *Fagus grandifolia*; red maple, *Acer rubrum*) left (west) bank.

Nonpoint source pollution inputs were not evident at CH01; however, sediment deposition—consisting of substantial sand-bar formation—affected much of the sampling reach. Origins of instream sedimentation here are unknown, although an active sand pit is located just upstream (off of Pudding Hollow Road). In addition, Route 8A crosses the river at several upstream points in the Chickley River subwatershed. CH01 received a total habitat assessment of 163/200 (Table A4). Sediment deposition, bank (east bank) erosion, and low base-flow affected habitat quality most negatively.

Benthos

The CH01 benthos assemblage received a total metric score of 32, representing 76% comparability to its primary reference station, CR01, and resulting in a biological assessment of "slightly impacted" (Table A2). Metric comparisons to the secondary reference station, VP11BEA, resulted in only 67% comparability to the "best-attainable" conditions and again a "slightly impacted" bioassessment (Table A3).

Most notable in the CH01 benthos analysis was the low value (0.04; score=0 relative to both reference stations) for the Scraperer/Filterer metric, suggesting an overabundance of FPOM in the CH01 sampling reach. Indeed, net-spinning forms of caddisflies (e.g., Hydropsychidae; Philopotamidae) were well-represented in the benthos sample (Table A1). These filter-feeders use silken nets to strain fine organic particulates from the water column. In addition, the reduced EPT/Chironomidae metric value relative to both the Bear River and Cold River reference stations indicates the displacement of pollution sensitive forms of EPT taxa by chironomids, generally considered more tolerant of conventional organic pollutants and corroborating the effects of organic enrichment in this portion of the river. Chironomids, specifically the numerically dominant *Polypedilum aviceps*, were the primary cause of point reductions for the Percent Dominant Taxon metric (Tables A1 and A2). In addition, the abundance of *P. aviceps* may reflect the low base-flow conditions observed during the biosurvey here, as this species is known to survive dry conditions or periods of reduced base-flow (Bode, NY DEC, personal communication).

Agricutural runoff—most notably from livestock, which have been observed wading in the river just upstream from CH01 (MA DEP 1997)—has been historically documented by MA DEP (1997) as the cause of high fecal coliform bacteria counts in the lower portion of the Chickley River. In other rural western Massachusetts watersheds, DWM has witnessed similar nonpoint source pollution inputs (e.g., cows wading in the stream channel or grazing nearby) just upstream from biomonitoring reaches that have resulted in similarly impacted (i.e., reduced EPT/Chironomidae and EPT Index metric values) benthic communities (Nuzzo 1999b).

In addition to agriculture-related organic inputs, the effects of enrichment seen in the biota at CH01 may result from its location downstream from numerous upstream impoundments. Productive conditions in these waterbodies may account for the delivery of FPOM to downstream communities such as CH01.

Fish

Fish sampling efficiency at CH01 was rated as poor. The presence of deep pools and fast-moving deep runs, as well as heavy downpours during the fish survey, limited both visibility and accessibility in much of the reach. Several habitat types were present for fish, including stable cover in the form of boulders, ledges, and deep pools. Fish species captured in order of abundance included Atlantic salmon, slimy sculpin, longnose dace, blacknose dace, brown trout and rainbow trout (*Onchorynchus mykiss*) (Table A5). Overall numbers were relatively low with a total of 44 fish being collected. All trout collected were large specimens that may have been stocked. The presence of two-year classes of Atlantic salmon was consistent with other streams in the watershed that receive fry stocking annually. Two of the three remaining species collected are classified as intolerant. In light of the presence of many intolerant species and despite the poor sampling efficiency it appears that the Chickley River is supporting a balanced fish community. It is unclear what effect the stocking of trout (and salmon) is having on the fish community in this segment.

North River

The fourth/fifth-order North River is formed by the confluence of its East and West Branches at the village of Griswoldville in the Town of Colrain. From here it flows south about three miles to its confluence with the Deerfield River. Both branches and the mainstem North River are similar, flowing through narrow, steep valleys. The flow is on a steep gradient and is shallow, rapid, and turbulent. Land-use in the North River subwatershed is dominated by mostly undeveloped forestland and light residential development. Agricultural (i.e., small-scale farming) activities are common along the North River and its East Branch—in many cases crops are planted immediately adjacent (i.e., minimally buffered) to the river. Streambank erosion, exacerbated by agriculture-related riparian disruption, has been documented by MA DEP (1997) at the East and West Branch confluence and has been addressed with BMP implementation (Duerring, EOEA Deerfield River Watershed Team, personal communication 2000). In addition, BBA Nonwovens possesses a NPDES permit for the discharge of industrial waste to the North River in the village of Griswoldville (MA DEP 2002a). Formerly permitted as Veratec, Inc., BBA is currently engaged in the manufacturing of non-woven products, as well as the bleaching and dyeing of woven/knitted fabrics. In addition, the facility treats the sanitary waste from nearby residences. There are two discharges from the BBA plant: 1) The biological wastewater (comprised of the process wastewater as well as the sanitary wastewater from the nearby residences) treatment system discharge; and 2) The Filter Backwash discharge. Effluent from the BBA discharge(s) (and Veratec, Inc. prior to that) has historically compromised instream aesthetics (water color) in this portion of the river (Fiorentino 1997; MA DEP 1999).

The USGS maintains a flow-gaging station in the village of Shattuckville (Colrain). Stream flow was 84 cubic feet/second (cfs) during the macroinvertebrate biomonitoring surveys at NOR01 and NOR02A (Table 3). Flow at the gage was 81 cfs during the fish population survey at NOR02A (Table 3).

NOR01—North River, mile point 0.80, 100 m upstream from Route 112, Colrain, MA.

Habitat

The NOR01 biomonitoring station began approximately 100 m upstream of Route 112 and about 1 km upstream of the confluence with the Deerfield River in the Shattuckville section of Colrain. Here the stream was approximately 10 m wide and 0.30 - 1 m deep. The open-canopied (<5% shaded) sampling reach meandered through a hemlock-dominated forest that was especially dense along the left (east) bank of the channel. The right (west) bank, consisting of a dense profusion of flood plain vegetation, was fairly well buffered from the road (approximately 50 m away). The dramatic series of rapids throughout the NOR01 reach provided macroinvertebrates with excellent habitat, with an abundance of rock substrates (cobble and boulder) and a variety of velocity/depth combinations. Deep riffles and pools with occasional submerged logs offered stable cover for fish as well. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Substrate embeddedness and sediment deposition were fairly minimal and confined to the slower pool areas that dominated the middle of the reach. Considerable algal growth was observed on cobble substrates throughout the reach, consisting of thin layers of green algae (i.e., periphyton) covering 90% of the stream bottom. Both stream banks were stable and well-vegetated with ferns, grasses, and other herbaceous (Japanese knotweed, *Polygonum cuspidatum*; smartweed, *Polygonum* sp.) growth. Riparian vegetation was undisturbed along the left (south) bank and well-established between the left bank and a nearby field. Riparian growth consisted of a shrubby (witch hazel, *Hamamelis* sp.; willow, *Salix* sp.) layer along the banks giving way to a forest of mostly hemlock (*Tsuga canadensis*), maple (*Acer* spp.), sycamore (*Platanus occidentalis*), elm (*Ulmus* sp.), and ash (*Fraxinus* sp.) trees.

Nonpoint source pollution was not observed in the sampling reach; however, sediment inputs were observed nearby. Road runoff is diverted to the river from Route 112 via a paved drainage swale, which enters the river just downstream from the bottom of the sampling reach. Here substantial deposits of sand were observed both instream and along the right (west) bank, where a small "beach" has developed (although some of this sand may be naturally occurring flood plain soil).

NOR01 received a habitat assessment score of 187, which was one of the highest scores received by a biomonitoring station during the 2000 survey (Table A4). Instream deposition and the adjacent agricultural activities (plowed field) compromised the overall habitat assessment only slightly.

Benthos

The macoinvertebrate community sampled at NOR01 received a total metric score of 36, representing 86% comparability to the Cold River (CR01) reference station and resulting in a "non-impacted" assessment for biological condition (Table A2). Despite slight reductions in the number of EPT taxa present in the NOR01 benthos assemblage, total taxa richness was higher here than at CR01. Relative abundance of the EPT taxa was also high (EPT/Chironomidae score=6), and coupled with a low Percent Dominant Taxon metric value (14%), indicates good community balance at NOR01.

It appears, then, that discharge loads generated from the BBA facility are assimilated by the North River before appreciable impacts are detected in the downstream biota, as reflected by the healthy macroinvertebrate assemblage observed at NOR01. Likewise, the effects of potential nonpoint source stressors (e.g., agriculture-related runoff and bank erosion) that may originate farther upstream from the sampling reach appear negligible or absent in this portion of the river.

Results of the 2000 biological assessment of the benthic community at NOR01 are consistent with those found in 1995, when the DEP biomonitoring efforts yielded a diverse, well-balanced macroinvertebrate community considered to be "non-impaired" (Fiorentino 1997).

NOR02A—North River (East Branch), mile point 9.40, 500 m downstream from Route 112, Colrain, MA.

Habitat

The NOR02A sampling station began approximately 500 m downstream from Route 112 in Colrain center. Land-use in the immediate area was mainly undeveloped forest, with some light residential and commercial development associated with the village of Colrain as well. This portion of the East Branch is minimally shaded (<5%) and wide (13 m), with depths of 0.30 – 0.90 m in the riffle-dominated sampling reach. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. An abundance of boulder and cobble substrates subjected to swift current velocity provided macroinvertebrates with excellent epifaunal habitat. Fish habitat was also optimal, with large boulders in deep pockets of water providing good cover. Instream algal cover was substantial—thin layers of green algae covered virtually all available hard substrates in both riffles and slower areas. Both stream banks were well-vegetated with ferns, mosses, and a shrub layer dominated by witchhazel (*Hamamelis virginiana*). Despite their steepness, banks were highly stable—the result of large boulders and established root masses along the margins of the stream channel. Riparian vegetative zone width was good, especially along the right (north) bank where a dense hardwood (elm; *Ulmus* sp.; sycamore, *Platanus occidentalis*; alder, *Alnus rugosa*; hop hornbeam, *Ostrya virginiana*) forest provided an unlimited buffer. Riparian growth was slightly compromised along the left (south) bank of the upper half of the reach due to an encroaching residential property. Yard waste (grass clippings, leaves, brush) and trash associated with this property provided a potential source of nonpoint pollution inputs to NOR02A. Road runoff originating from the Route 112 crossing just upstream from NOR02A is also a potential pollution source.

NOR02A received a total habitat assessment score of 190/200—higher than both reference stations in the Deerfield River watershed (Table A4). Only one other station scored better during the 2000 biomonitoring survey.

Benthos

The NOR02A benthos assemblage received a total metric score of 34, which was 81% comparable to the CR01 community and placed the benthos intermediate to the “non-” and “slightly impacted” categories for biological condition (Table A2).

Coupled with a slightly reduced metric value for EPT Index and a somewhat elevated Biotic Index, the reduced EPT/Chironomidae metric value (score=2) relative to the CR01 reference station indicates the displacement of pollution sensitive forms of EPT taxa by chironomids, generally considered more tolerant of conventional organic pollutants. *Polypedilum* spp. were particularly abundant at NOR02A, comprising more than 25% of the sample (Table A1). Interestingly, this genus was also well-represented in the 1995 macroinvertebrate sample taken here by DEP (Fiorentino 1997). The numerical dominance of the NOR02A benthos by the chironomid *Polypedilum flavum*, which can be numerous in streams with high concentrations of suspended organic particulates (Bode and Novak 1998), further corroborates the slightly enriched nature of this stream system. That similar enrichment effects were not observed in the benthic community farther downstream at NOR01 may be due in part to the increased assimilative capacity of the North River after receiving considerable discharge contributions from the West Branch North River.

Other metrics performed comparably to reference conditions. Most notably, Taxa Richness was higher at NOR02A than at the Cold River station. And high scores (score=6) for both the Scraper/Filterers and Percent Dominant Taxon metrics suggest generally good community balance and trophic structure here despite the abundance of *Polypedilum* spp.

Fish

Fish sampling efficiency at NOR02A was rated as poor. The presence of wide, deep stretches and fast-moving runs made sampling difficult in the reach. All habitat types were present. Fish species captured in order of abundance included Atlantic salmon, longnose dace, blacknose dace, banded killifish (*Fundulus diaphanous*), tessellated darter (*Etheostoma olmstedi*), and yellow bullhead (*Ameiurus natalis*) (Table A5). Overall numbers were relatively low with a total of 30 fish being collected. The presence of Atlantic salmon is consistent with other streams in the watershed that receive fry stocking annually. Due to poor sampling efficiency, it is unclear whether this reach is supporting a balanced fish community. It is also unclear what effect, if any, the stocking of salmon is having on the fish community in this segment.

Taylor Brook

A small, second/third order stream, Taylor Brook is formed by the merger of Kinsman and Davenport brooks near the Colrain-Heath border. The stream flows east through mainly undeveloped forest (with the exception of the Heath Estates residential development) before joining the North River’s West Branch near the Adamsville section of Colrain, approximately two miles upstream from the mainstem North River.

TB00—Taylor Brook, river mile 0.20, 100 m upstream from Heath Road, near mouth, Colrain, MA.

Habitat

The TB00 biomonitoring station began 100 m upstream from Heath Road and approximately 0.20 miles upstream from Taylor Brook's confluence with the West Branch of the North River. The fully (100%) shaded, high-gradient stream reach was approximately 5 m wide, with a depth of 0.10 – 0.50 m. Cobble substrates and riffle-dominated flow regimes provided excellent epifaunal habitat for benthic organisms, while submerged woody materials and boulders offered optimal cover for fish. Some substrates were unavailable as fish and macroinvertebrate habitat, however, as marginal channel flow status (channel only 50% full) resulted in cobble/gravel bars mid-channel and a fair amount of exposed substrates along the margins of the stream.

Both stream banks were well-vegetated with ferns and mosses before giving way to wide riparian zones. The riparian buffer was especially extensive along the right (south) bank, consisting of a dense evergreen/deciduous forest of shrubs (mountain laurel, *Kalmia latifolia*; witchhazel, *Hamamelis virginiana*) and stands of hemlock (*Tsuga Canadensis*), yellow birch (*Betula alleghaniensis*), slippery elm (*Ulmus* sp.), and white ash (*Fraxinus* sp.).

Bank stability was good within the reach; however, serious bank erosion resulting in "raw" areas and obvious bank sloughing was observed immediately upstream from the sampling reach along the right (south) bank. In addition, a large area of erosion was noted further upstream of the sampling reach on the southern bank under a power line crossing. Bank erosion, which to some degree may be naturally-occurring, may be at least partially responsible for the considerable instream sediment deposition and slight turbidity observed at TB00. Upstream road crossings (Heath Road intersects Taylor Brook numerous times along its course) may contribute sediment loads as well.

TB00 received a total habitat assessment score of 157/200—the third lowest score received by a biomonitoring station during the 2000 survey (Table A4). Instream habitat constraints related to low base-flow and sedimentation compromised habitat quality the most here.

Benthos

The benthos assemblage at TB00 received a total metric score of 38, which was highly (90%) comparable to the reference condition at VP11BEA and resulted in a "non-impacted" assessment for biological condition (Table A3). Pollution sensitive EPT taxa were well represented in the TB00 benthos sample, while total taxa richness was slightly higher than the reference station. Affinity to the reference station was extremely high—in fact, a Reference Affinity of 84% was the highest of all biomonitoring stations being compared to VP11BEA. And although the Percent Dominant Taxon metric suffered point reductions, this was mainly the result of high densities of the mayfly *Serratella* sp., a highly intolerant taxon that requires well-oxygenated waters.

Potential nonpoint source pollution inputs (e.g., septic leachate) originating from Heath Estates do not appear to influence biological integrity in this portion of Taylor Brook, as evidenced by the diverse and well-balanced macroinvertebrate community observed. Rather, the greatest threat to the resident benthos at TB00 is probably instream sedimentation—presumably originating from streambank instability (i.e., erosion) and/or road runoff. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the interstitial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish spawning habitat and egg incubation. While it is possible that the high-gradient nature of Taylor Brook allows for the "flushing through" of sediments before they can be a significant impediment to the integrity of resident biota, future biological impairment related to increased sediment loads here, as well as impacts farther downstream in the West Branch North River, should be considered.

Fish

Fish sampling efficiency at TB01 was rated as good (70% pickup). The reach included stable habitat for fish in the form of boulders, shallow and deep riffles, isolated small pools, and some woody debris. Pools located on the stream margins appeared to be filled with fine sediment. A total of 71 fish were collected. Species presence and relative abundance has been documented; however, the original field sheets are no longer available. The fish community at TB01 was dominated by intolerant fishes, including slimy sculpin, Atlantic salmon, longnose dace, and eastern brook trout. Longnose dace, brown trout, blacknose dace, and white sucker were also present (Table A5). Continued sedimentation of this stream reach threatens habitat, which may in turn have a negative effect on overall numbers of fish this reach is able to support. As is the case with all the other reaches that are stocked with Atlantic salmon, it is unclear what effect, if any, fry stocking is having on the other fish present.

South River

The third-order South River originates as the outlet from Ashfield Pond in Ashfield. The river flows east approximately seven miles to Conway. The gradient is generally steep, and the velocity accordingly rapid—the exception being two swampy areas that briefly break the gradient. After receiving discharge contributions from Pumpkin Hollow Brook, a first-order stream in Conway, the South River turns almost directly north and flows north and then east for six miles at a steep gradient to the Deerfield River—near-stream, small-scale agriculture is common along its course and has historically compromised and/or threatened water quality in this portion of the river (Fiorentino 1997; MA DEP 1997; MA DEP 1999). This stretch of the South River is swift-flowing and is not interrupted by any breaks in the gradient. The South River indirectly receives the treated effluent (via groundwater discharge) of the Ashfield WWTP—an alternative technology (Solar Aquatics) wastewater treatment facility (MA DEP 2002a). Much of the light residential and commercial development in the South River subwatershed is concentrated in the centers of Conway and Ashfield.

The USGS maintains a flow-gaging station in Conway. Stream flow was 26 cfs during the macroinvertebrate biomonitoring survey at the nearby SOR01 station. During the fish population survey at SOR01, flow was 21 cfs (Table 3).

SOR01—South River, mile point 2.50, 50 m upstream from Truce Road and USGS gage, Conway, MA.

Habitat

SOR01 began approximately 50 m upstream of Truce Road and the USGS gaging station, where the stream meanders through a forest of hemlock and mixed hardwoods. This mostly (60%) shaded portion of the South River was approximately 9 m wide with an average depth of 0.25 m in the riffle areas and 0.40 m in the pools. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Substrates were dominated by cobble, boulder, and gravel, providing generally good habitat for macroinvertebrates; however, epifaunal microhabitat was somewhat reduced due to substrate embeddedness and instream sediment deposition. A considerable amount of sand had also been deposited along the left (north) bank in the vicinity of the gaging station just below the sampling reach, probably the result of runoff from Truce Road. Fish habitat was also optimal—in addition to large boulders, submerged logs and snags provided a mix of stable cover. Instream aquatic vegetation was absent, although thin layers of periphyton covered the substratum in most of the reach.

Riparian and bank structure were good—both banks were well stabilized with vegetation (moss, ferns, grasses) and boulders, with only occasional areas of erosion observed along the steep right (south) bank. Riparian vegetation was well established along both sides of the stream—grasses and herbaceous (ferns) growth dominated the stream margins, giving way to shrubs (witchhazel, *Hamamelis virginiana*) and trees (white ash, *Fraxinus* sp.; elm, *Ulmus* sp.; hemlock, *Tsuga canadensis*; red maple, *Acer rubrum*; yellow birch, *Betula allaghaniensis*) farther from the banks.

SOR01 received a total habitat assessment score of 170/200 (Table A4). Though overall instream habitat was considered good in the sampling reach, sediment deposition and associated substrate embeddedness continue to threaten benthic habitat quality here—as was noted during the previous DEP biomonitoring survey conducted in 1995 (Fiorentino 1997).

Benthos

Unlike the 1995 bioassessment conducted here, CR01 was used as the primary reference station for the SOR01 benthic community, with benthos metric comparisons resulting in an assessment of "non-impacted" based on 95% comparability to the reference (Table A2). When using the Bear River station as a reference—as was the case in 1995—the SOR01 benthic community was again found to be "non-impacted" and highly comparable (90%) to reference conditions (Table A3).

Several metric values for the SOR01 benthos assemblage—most notably Taxa Richness and EPT Index—equaled or outperformed those for both reference stations. Richness metric values almost doubled those calculated here during the 1995 biosurvey (Fiorentino 1997). In addition, community structure (composition and dominance) at SOR01 in 2000 appeared markedly better than during the previous survey. Better trophic balance was also evident in the macroinvertebrate community sampled here in 2000 compared to the 1995 community—filter-feeders, in particular, were less numerically dominant here than during the previous biosurvey, indicating the importance now of food resources other than FPOM in this portion of the South River. That the 2000 survey found a reduction in the number of filter-feeding taxa—and to a lesser extent, algal scrapers—suggests the effects of organic/nutrient enrichment may not be as pronounced here as during the 1995 biomonitoring survey.

The apparent improvements in water quality and associated biological integrity here may be the result of agricultural BMP implementation upstream, elimination of failing septic systems through sewering, and/or upgrades to the Ashfield WWTP since the 1995 biosurvey. In addition, effects from the instream habitat degradation documented in 1995—though still an ongoing threat to aquatic habitat potential here—may have also been reduced

Fish

Fish sampling efficiency at SOR01 was rated poor. This was mostly due to the width of the stream and the presence of extensive riffle/run type habitat. It was difficult to keep fish ahead of the electrical field and many fish were seen escaping downstream and to the sides of the electrofishing crew. Overall numbers of fish collected were low (n=53). Fish species captured in order of abundance included blacknose dace, Atlantic salmon, common shiner (*Luxilus cornutus*), longnose dace, and creek chub (*Semotilus atromaculatus*) (Table A5). The presence of two intolerants is indicative of good water and habitat quality; however, the sample was dominated by more tolerant species and may be indicative of higher productivity or watershed nonpoint source impacts such as agriculture. It is unclear as to what effect, if any, the stocking of Atlantic salmon fry may be having on brook trout, which were not collected within this reach.

Pumpkin Hollow Brook

PH00—Pumpkin Hollow Brook, mile point 0.20, 100 m upstream from Academy Hill Road, Conway, MA.

The PH00 sampling reach began approximately 150 m upstream from Academy Hill Road in the center of Conway. The fully (100%) shaded reach was located just upstream of a baseball field. The stream was only about 3 m wide with an average depth of 0.25 m in the riffle areas and up to 0.50 m in the deepest "plunge" pools. Channel flow status was optimal, with water reaching the base of both banks and leaving very little exposed substrates. The cobble-dominated stream bottom and swift current velocity offered good habitat for macroinvertebrates; however, occasional instream deposits of silt/sand and associated substrate embeddedness was problematic. Instream mosses provided additional epifaunal microhabitat. Other forms of aquatic vegetation and algae were absent. Fish habitat was slightly less than optimal, with snags and small pools providing most of the stable cover. Pool areas, while of adequate depth, were affected by sediment deposition and bar formation.

Both stream banks were fairly well-vegetated with mosses and herbaceous growth. Bank instability was observed along the left (west) bank, where the steep nature of the bank resulted in small areas of erosion. Bank erosion was most severe at the downstream end of the 100 m sampling reach. Riparian vegetation grew undisturbed along the left (west) bank, with riverbank grape (*Vitis* sp.) along the stream margin giving way to various hardwoods (maple, *Acer* sp.; ash, *Fraxinus* sp.; cherry, *Prunus* sp.). A narrow layer of trees and herbaceous (blackberry, *Rubus allegheniensis*; greenbrier, *Smilax rotundifolia*) understory vegetation provided a riparian buffer from the adjacent ball field along the right (east) bank.

PH00 received a total habitat assessment score of only 146/200—the second lowest habitat score received by a biomonitoring station during the 2000 survey (Table A4). Instream sediment deposition and substrate embeddedness clearly affect overall habitat quality most negatively here. Sediment inputs may originate from erosional areas along the left (west) bank of the sampling reach or farther upstream where severe bank erosion (i.e., "landslides") was observed, in addition to agricultural activities farther upstream (near Maple Street and Old Cricket Hill Road) where heavy siltation was observed during spring field reconnaissance.

Fish

Fish sampling efficiency at PH00 was rated as excellent (>80% pickup). The reach included stable habitat for fish in the form of boulders, isolated small pools, and some woody debris. Some of the pools contained deposits of fine sand, and moderate embeddedness of cobble substrate was noted. A total of 315 fish were collected. In addition, young of the year creek chub and common shiner were noted as being too numerous to count. The fish community at PH00 was dominated by moderately tolerant (creek chub and common shiner), and tolerant (blacknose dace) species. Brook trout, Atlantic salmon, and longnose dace were also present, however their numbers were very low. (Table A5). The relative scarcity of Atlantic salmon is to be expected as this reach is not stocked with fry. Fish numbers were extremely high which leads one to suspect that nutrient enrichment from upstream nonpoint sources (e.g., agriculture, landfill) may be having an effect on this reach. Continued sedimentation of this stream reach threatens habitat, especially in the pool areas.

Deerfield River

The Massachusetts portion of the fifth-order Deerfield River begins from the Vermont-Massachusetts border, which intersects the Sherman Reservoir on the Massachusetts side at Monroe and Rowe. From here the Deerfield River meanders south and west through the narrow valley forming the border first between Monroe and Rowe and then Rowe and Florida. In this stretch it flows over the dam at Sherman Reservoir and New England Power Dam #5 at Monroe Bridge. About five miles farther downstream, the hydroelectric Fife Brook Dam impounds the river and releases water from the hypolimnion. As the river reaches the eastern portal of the Hoosac Tunnel it turns south and east entering Charlemont where the gradient lessens. The river continues eastward, receiving considerable discharge contributions from the Cold River near Route 2 in the Mohawk Trail State Forest, Charlemont.

From the confluence with the Cold River in Charlemont the Deerfield River flows about a mile and a half before being joined by the Chickley River in Charlemont. Approximately one mile below Charlemont center the river becomes the boundary between Buckland and Charlemont flowing east about four miles through a fairly broad valley. As the river passes under Route 2 it turns north flowing over a hydroelectric dam and is joined at the top of its northward loop by the North River at the border of Charlemont, Buckland and Shelburne.

From the confluence with the North River, the Deerfield River heads due south through the towns of Buckland and Shelburne Falls. It then resumes a southeasterly course passing over three hydroelectric dams in the next three miles. The river continues to form the boundary between Buckland and Shelburne and then Conway and Shelburne and finally Conway and Deerfield before entering Deerfield. In this stretch the river is joined by the Bear and South rivers. In Deerfield, the river enters a broad valley where the bedrock changes from metamorphic and igneous rock to sedimentary sandstone and shale. The velocity in this stretch slows due to low gradient and backwater from the Connecticut River. As the river passes under Interstate 91, it meanders north again through South and North Meadows paralleling the highway. At the border between Deerfield and Greenfield the river turns east again and is joined by the Green River at the golf course in south Greenfield.

The USGS maintains flow-gaging stations in Charlemont and in the village of West Deerfield (Deerfield). At the West Deerfield gage, which is approximately 1.5 miles upstream from the macroinvertebrate biomonitoring station at LDR01, flow was 476 cfs during the time of the biosurvey (Table 3).

LDR01—Deerfield River, mile point 8.0, 400 m downstream from Stillwater Bridge, Deerfield, MA.

Habitat

LDR01 was located approximately midway between the Stillwater Bridge and Interstate 91, in a relatively undeveloped portion of the Deerfield River. A wide (35 m) and open-canopied (<5% shaded) portion of the Deerfield River, the LDR01 sampling reach ranged in depth from 0.30 m – 1 m. Channel flow status was good, with water easily reaching the base of both banks. An abundance of cobble and boulder substrates, subjected to a variety of velocity/depth combinations provided excellent epifaunal habitat for macroinvertebrates. Deep riffles and pools with large boulders offered stable cover and good habitat for fish. Instream algal cover was substantial, with a thin layer of periphyton covering most rocky substrates and occasional patches of filamentous green algae present as well.

Bank and riparian habitat parameters scored highly. Banks were well-vegetated with herbaceous vegetation (especially Japanese knotweed, *Polygonum cuspidatum*) and stabilized with large boulders and root masses. A forested riparian zone—comprised of shrubs (rose, *Rosa* sp.; dogwood, *Cornus stolonifera*; buckthorn, *Rhamnus* sp.) and deciduous trees (maple, *Acer* spp.; sycamore, *Platanus occidentalis*; elm, *Ulmus* sp.)—extended undisturbed from the left (north) bank and provided a good vegetative buffer from the nearby road (Stillwater Road) along the right (south) bank. There was no evidence of nonpoint souce pollution.

LDR01 received a habitat assessment score of 192/200, which was higher than that received by the Cold River reference site. In fact, habitat at LDR01 rated higher than any other biomonitoring station in the 2000 Deerfield River watershed (Table A4).

Benthos

The macroinvertebrate community observed at LDR01 reflected the excellent aquatic habitat afforded it. The benthos assemblage received a total metric score of 38, representing 90% comparability to the Cold River reference station and resulting in an assessment of “non-impacted” for biological condition (Table A2).

In is unclear if biological integrity has improved or remained the same here since the 1995 biosurvey, when the LDR01 benthos assemblage was found to be “non-impacted” compared to an upstream reference station not sampled during the 2000 biosurvey (Fiorentino 1997). However, community structure appears better here than during the 1988 biosurvey, when benthos comparisons at that time were made to reference conditions on the Cold River and found the LDR01 community to be “slightly impaired” (Fiorentino 1997). Two filter-feeding taxa (*Isonychia* sp., *Hydropsyche morosa* gr.) comprised more than half the assemblage sampled in 1988—the number of these and other filter-feeders was greatly reduced in the 2000 benthos sample observed here, replaced instead by scraping forms indicative of more balanced trophic structure and a shift towards a periphyton-based macroinvertebrate community. Indeed, thin layers of periphyton were observed on virtually all available rocky substrates in the LDR01 sampling reach during the 2000 biosurvey.

Green River

The fourth-order Green River rises in Vermont and flows south to Massachusetts. In Massachusetts it flows generally south, with Colrain on the west and Leyden on the east, to the City of Greenfield. It then continues in a southerly direction through Greenfield to its confluence with the Deerfield River in Greenfield.

In its upper reaches the Green River is a shallow, swift, and turbulent mountain stream. Soon after it enters Greenfield, the gradient begins to level off—the velocity drops off and the river becomes deeper. Water quality becomes increasingly degraded as the river receives urban runoff from Greenfield. Downstream from Interstate 91, the Green River flows through a fairly flat section at a low velocity. About one-half mile downstream from the Route 2A bridge near the center of Greenfield, the gradient again steepens and the river flows quickly for a mile before it encounters the backwater from the Deerfield River in its last half mile. Effluent from the Greenfield WWTP is discharged into this last portion of the Green River (MA DEP 2002a).

The USGS maintains a flow-gaging station in the village of West Leyden (Colrain). Stream flow was 39 cfs during the macroinvertebrate biomonitoring survey at GR02 and 37 cfs during the biosurvey at GR01 (Table 3).

GR01—Green River, river mile 0.75, 150 m downstream from footbridge off Route 5-10, Greenfield, MA

Habitat

Sampling was conducted approximately 150 m downstream from an unnamed footbridge off Route 5/10, approximately midway between the Meridian Street bridge and the confluence with the Deerfield River. The partially (50%) shaded sampling reach was approximately 16 m wide and 0.30 - 0.80 m deep. Unlike the dammed portions of the Green River immediately upstream, adequate current velocity and an abundance of hard substrates (cobble and gravel) provided macroinvertebrates with overall excellent habitat throughout the sampling reach. Moderate embeddedness did compromise epifaunal habitat, however, especially in the slower run areas where substrates were almost 50% surrounded by fine materials. Fish habitat was also good, especially in the occasional pool areas where boulders and woody material provided stable cover. Less than optimal channel flow status (channel <75% full) resulted in a fair amount of exposed substrates along the margins of the stream.

Some areas of severe erosion were observed along the steeper portions of both banks. The considerable bank instability may be exacerbated by the removal of bank vegetation, which has resulted in areas of bare soil on both sides of the channel. Potential nearby sources of nonpoint source pollution were the residences along the left (east) bank, and the playing fields and parking lot adjacent to the right (west) bank. Riparian vegetation, consisting of a thin layer of trees (silver maple, *Acer saccharinum*; elm, *Ulmus* sp.), shrubs/vines (riverbank grape, *Vitis* sp.; bittersweet, *Celastrus* sp.) and grasses provided only a very narrow buffer from these disturbances. In addition, trash deposits were observed in the sampling reach during the biosurvey.

GR01 was located downstream of downtown Greenfield and a number of potential water quality stressors associated with its urban setting. Urban runoff and industrial activities have historically degraded water quality and biological integrity in this portion of the Green River (Fiorentino 1997; MA DEP 1989; MA DEP1997; MA DEP 1999). Discharge points from numerous storm drains enter the river a short distance upstream from the sampling station; however, it is anticipated that improvements in stormwater management (e.g., BMPs such as StormTreat™) in the City of Greenfield, including the elimination of dry-weather stormdrain discharges, may reduce the effects of stormwater runoff. Instream turbidity was noted during the biosurvey here.

GR01 received a total habitat assessment score of 135/200—the lowest habitat evaluation for a Deerfield River watershed biomonitoring station (Table A4). Degraded bank (i.e., bank vegetation and stability) and riparian habitat parameters contributed most to the low overall assessment.

Benthos

Despite the habitat constraints observed in the GR01 sampling reach, the benthic community received a total metric score (38) that was highly (90%) comparable to its reference station at CR01 (Table A2). In fact, metrics calculated for the GR01 benthos outperformed those for CR01 for all but two metrics, and suffered point reductions for only one metric (EPT Index). Most surprising was total Taxa Richness—38 was the highest received by any biomonitoring station in the 2000 survey, including both reference stations (Tables A2 and A3). In addition, a Scraper/Filterer metric value of 1.70—the highest of all the biomonitoring stations—coupled with a low percentage (14%) for the Dominant Taxon (*Glossosoma* sp., which has a TV of only 0), indicate balanced community structure and trophic structure in the GR01 macroinvertebrate community.

The resulting 2000 biological assessment of GR01, "non-impacted", was considerably better than the assessments received following both the 1988 and 1995 DEP biosurveys here. In 1988, comparisons of the GR01 benthos to the reference station (CR01) resulted in a bioassessment of "moderately impaired", with an assemblage structured in response to possible toxic effects (Fiorentino 1997). The 1995 biomonitoring efforts here again found a "moderately impaired" macroinvertebrate community that was highly dissimilar to the reference community; and while toxic impacts were thought to have diminished, continued water quality degradation related to urban runoff and productive upstream impoundments was inferred (Fiorentino 1997). More than one-third of the benthos assemblage sampled in 1995 consisted of filter-feeding hydropsychid caddisflies, indicating an unbalanced community and an overabundance of the FPOM food resource in this portion of the river. Metric values calculated for the 2000 benthos suggest GR01 has returned to more balanced conditions in terms of community composition and trophic structure—richness metrics have more than doubled since the 1995 biosurvey, and scrapers such as elmid beetles and the highly sensitive glossosomatid caddisfly, *Glossosoma* sp. (TV=0), have displaced filter-feeders as the dominant trophic guild. In fact, only 9 hydropsychids were recorded in the 2000 benthos sample (Table A1).

Comparisons of the 2000 benthos data at GR01 to previous sampling years should be made with caution due to the potential for metric variability attributable to natural (e.g., temporal) factors. However, this most recent biological assessment of the GR01 aquatic community—based on comparisons to current reference conditions—is encouraging, and is strongly suggestive of improvements in water quality in this portion of the Green River, possibly the result of improved stormwater management and controls of other nonpoint source pollution associated with urban runoff. In fact, habitat quality at GR01 may now be more limiting to the resident biota than water quality factors. The urbanized nature of this portion of the Deerfield River watershed continues to undermine habitat quality and biological potential at GR01, particularly with regard to riparian and instream habitat parameters.

GR02—Green River, river mile 7.0, 200 m downstream from Eunice Williams Drive and covered bridge, Greenfield, MA

Habitat

The GR02 sampling reach began approximately 200 m downstream from the dam at Eunice William Drive in Greenfield. This portion of the river was wide (15 m) and relatively shallow (0.20 – 0.40 m), dominated by fast water and with a completely open (0% shaded) canopy. Instream substrates were mainly comprised of cobble, providing excellent epifaunal habitat for macroinvertebrates. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. The somewhat homogeneous nature of these substrates, however, and a lack of other types (e.g., boulders, snags, logs, etc.) of stable cover and flow regimes (e.g., pools, etc.), led to less than optimal habitat conditions for fish.

Both stream banks were well-vegetated with grasses, ferns, and various herbaceous growth. In addition to vegetative growth, boulders provided good bank stability. A forested (white birch, *Betula populifolia*; sycamore, *Platanus occidentalis*) riparian zone grew undisturbed along the right (west) bank. Along the left (east) bank, a shrub layer of staghorn sumac (*Rhus typhina*) and additional trees provided an adequate vegetative buffer from an adjacent field. Nonpoint source pollution inputs were not observed, although the upstream road crossing was a potential source of runoff.

GR02 received a total habitat assessment score of 169/200 (Table A4). The shallow nature of the sampling reach, along with somewhat limited fish cover, contributed most to point reductions during habitat scoring. Channel alterations associated with the upstream bridge abutments and nearby dam also affected the overall habitat evaluation.

Benthos

The GR02 benthic community received a total metric score of 42—the only study station in the 2000 Deerfield River watershed survey to receive the maximum-attainable total metric score. This high (100%) comparability to the Cold River reference station resulted in a “non-impacted” assessment for biological condition (Table A2). Virtually all metrics outperformed those for the reference community. In fact, an EPT Index of 18 was higher than any other biomonitoring station in the Deerfield River watershed survey, while a Biotic Index of 3.01 was the lowest—indicating an assemblage dominated by pollution sensitive taxa. In addition, the high scoring Scraper/Filterer metric value indicates balanced trophic structure and the importance of a periphyton-based macroinvertebrate community here. Indeed, thin layers of algae (probably diatoms) were observed on much of the rocky substrates in the sampling reach, providing an important food resource for algal grazers such as heptageniid mayflies which were abundant in the GR02 benthos sample (Table A1).

Prior to the 2000 biosurvey, GR02 was last sampled by DEP in 1988, when the benthic community was found to be “non/slightly impaired” relative to the reference station located in the Cold River at CR01 (Fiorentino 1997). It is not clear whether the discrepancy in assessments between the two sample years is a result of improved water quality since the 1988 biosurvey, or community differences attributable to temporal variability.

SUMMARY AND RECOMMENDATIONS

Cold River

CR01

Benthos: Watershed reference for study stations in third to fifth-order streams.
Habitat: Watershed reference for study stations in third to fifth-order streams.

The CR01 benthic community was thought to represent the “best attainable” conditions in the watershed with respect to biological integrity, habitat quality, and water quality. As a reference condition, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005, especially if evaluations of third to fifth-order stream biota are again planned. Fish population sampling, using multiple crews or a barge-mounted electrofishing unit due to the wide nature of this sampling reach, should accompany the macroinvertebrate sampling effort.

Despite good water quality and a healthy aquatic community, the extent of algal cover at CR01 was surprising. An investigation of the waste disposal practices at the upstream campground is recommended.

Bear River

VP11BEA

Benthos: Watershed reference for study stations in first to third-order streams.
Habitat: Watershed reference for study stations in first to third-order streams.

The VP11BEA benthic community was thought to represent the “best attainable” conditions in the watershed with respect to biological integrity, habitat quality, and water quality. As a reference condition, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005, especially if evaluations of first to third-order stream biota are again planned. Fish population sampling, which has not historically been performed by DEP at this station, should accompany the macroinvertebrate sampling effort.

Runoff associated with the nearby road threatens water quality, habitat quality and biological potential at VP11BEA. As the riparian buffer between Shelburne Falls Road and this portion of the Bear River is thin, road salting/sanding during winter months should be kept to a minimum here.

Pelham Brook

PB01

Benthos: "Non-impacted" compared to reference station.
Habitat: 100% comparable to reference station.

Several of the metrics calculated for the PB01 benthos assemblage outperformed those for the reference community. Based on the biological assessment of the macroinvertebrate and fish community encountered at PB01, it appears that water quality effects related to the upstream landfill and/or impoundment are absent or imperceptible here. The resident biota, instead, appear to reflect the diverse and high quality habitat afforded them in this portion of Pelham Brook.

Davis Mine Brook

DM00

Benthos: "Severely impacted" compared to reference station.
Habitat: 99% comparable to reference station.

While this stream is currently 303(d)-listed due to pH and habitat alteration (MA DEP 1999), toxicity should be considered as an additional pollutant/stressor for its entire segment. Water quality degradation, particularly as it relates to the acid mine drainage upstream, is clearly having a dramatic, and probably toxic, effect on aquatic life in Davis Mine Brook. In addition to obvious impairment of the macroinvertebrate community at DM00, the fish community has been completely eliminated—no fish were collected or observed during the fish population survey here. Options will need to be explored with regard to the cessation of acid mine drainage in this subwatershed. If the Aquatic Life use of Davis Mine Brook is to be supported in the future, restoration of this stream—including a "clean-up" at its source—should be a Deerfield River watershed priority.

Additional threats to resident biota at DM00, and farther downstream in Mill Brook, exist in the form of riparian disruptions associated with a private landfill located immediately adjacent to the DM00 sampling reach. An investigation of the landfill and its contents is highly recommended, especially to determine the presence/absence of hazardous materials. Outreach efforts are recommended to educate the abutting landowner on how improper yard waste and trash disposal can impact aquatic life "in his/her own back yard," as well as the importance of maintaining a riparian buffer zone.

Mill Brook

MB01

Benthos: “Slightly impacted” compared to reference station.
Habitat: 100% comparable to reference station.

Water quality perturbations other than organic loadings may compromise biological (fish and macroinvertebrates) integrity in this portion of Mill Brook. As the MB01 biomonitoring station is only about 2 km downstream from the Davis Mine Brook confluence, it is possible that the effects of the acid mine drainage observed at DM00 persist here as well—though not to the extent seen at Davis Mine Brook. Cessation of further acid mine drainage, if determined to be feasible, will likely do much to improve biological conditions in Mill Brook below the Davis Mine Brook confluence. In addition, the dumping of trash (mentioned above) near the confluence of Davis Mine Brook threatens water quality and biological integrity in this portion of Mill Brook and should be addressed through site-visits (especially to determine the presence/absence of hazardous waste materials) and outreach.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling should accompany the macroinvertebrate sampling effort. As water quality rather than habitat quality appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be instrumental in determining the specific types of water quality degradation present here.

Chickley River

CH01

Benthos: “Slightly impacted” compared to both primary (CR01) and secondary (VP11BEA) reference stations.
Habitat: 92% comparable to primary reference station; 93% comparable to secondary reference station.

Water quality appears to limit biological potential here, as reflected in a macroinvertebrate community structured in response to organic enrichment. Nutrient/organic loadings associated with upstream agricultural runoff and/or productive upstream impoundments are a likely source of water quality degradation in this portion of the watershed. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. BMPs to control livestock-related nonpoint source pollution may be necessary at some of the farms located upstream from the CH01 sampling station. BMPs already in place may require an evaluation of their effectiveness.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling, which proved difficult during the 2000 biosurvey due to deep water and heavy downpours, should accompany the next macroinvertebrate sampling effort. Fish population assessments should be conducted using multiple crews or a barge-mounted electrofishing unit. In addition, water quality monitoring throughout the Chickley River subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.

North River

NOR01

Benthos: "Non-impacted" compared to reference station.
Habitat: 100% comparable to reference station.

Despite the excellent aquatic health observed at NOR01, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess the potential impacts of the industrial discharge upstream, as well as various nonpoint source effects related to agriculture and urban runoff in this portion of the North River subwatershed. In addition to benthic macroinvertebrate biomonitoring, attempts should be made to conduct fish population sampling as well. Due to the wide and deep nature of the NOR01 sampling reach, fish population sampling should employ multiple crews or a barge-mounted electrofishing unit.

East Branch North River

NOR02A

Benthos: "Non/Slightly impacted" compared to reference station.
Habitat: 100% comparable to reference station.

The displacement of pollution sensitive forms of EPT taxa by chironomids—most notably the midge *Polypedilum flavum*, which can be numerous in streams with high concentrations of suspended organic particulates (Bode and Novak 1998)—is evidence of the slightly enriched nature of this stream system. Nutrient/organic loadings originating from various forms of runoff (especially upstream agriculture, road crossings, and NPS inputs originating from Colrain center) probably contribute to the productive conditions in this portion of the East Branch. A thorough investigation of land-use practices in this subwatershed, and the need for BMP implementation or other controls of nonpoint source pollution, is recommended. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. Despite the threat of nonpoint source pollution impacts to the NOR02A biota, the presence of a well-balanced fish community dominated by intolerant species suggests this stream continues to fully support its Aquatic Life use.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring throughout the East Branch subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.

Taylor Brook

TB00

Benthos: "Non-impacted" compared to reference station.
Habitat: 89% comparable to reference station.

Although the resident biota at TB00 were found to be non-impacted, instream and riparian habitat degradation was observed. The greatest threat to the macroinvertebrate and fish community in this portion of Taylor Brook is probably instream sedimentation—presumably originating from streambank instability (i.e., erosion) and/or road runoff. While it is possible that some streambank erosion is naturally occurring in this subwatershed, erosion may be exacerbated by areas of riparian and bank deforestation—particularly where high-tension power lines cross the stream. In addition, an investigation of all upstream road crossings should be made to determine the need for BMPs.

It is possible that the high-gradient nature of Taylor Brook allows for the “flushing through” of sediments before they can be a significant impediment to the health of resident biota. However, biomonitoring (fish and macroinvertebrates) is recommended here during the next DEP Deerfield River watershed survey in 2005 to assess potential impacts related to increased sediment loads here. Potential impacts farther downstream in the West Branch North River, should also be considered.

South River

SOR01

Benthos: “Non-impacted” compared to both primary (CR01) and secondary (VP11BEA) reference stations.
Habitat: 96% comparable to primary reference station. 97% comparable to secondary reference station.

Though the fish assemblage observed here suggests some degree of instream productivity, the benthic community appeared considerably more healthy than during the previous biosurvey conducted here in 1995. The apparent improvements in water quality, habitat quality, and associated biological integrity documented here may be the result of agricultural BMP implementation upstream, elimination of failing septic systems through sewering, and/or upgrades to the Ashfield WWTP since the 1995 biosurvey. While this portion of the river appears to fully support the Aquatic Life use, DEP/DWM’s Assessment Program should conduct a review of current water quality data (if available) collected here during the 2000 watershed survey to determine if this segment should be removed from the Massachusetts Section 303(d) List of waters.

Macroinvertebrate biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling, using multiple crews or a barge-mounted electrofishing unit, should accompany the macroinvertebrate sampling effort.

Pumpkin Hollow Brook

PH00

Fish only: “Slightly impacted” based on best professional judgement.
Habitat: 83% comparable to the reference station.

The numerical dominance of moderately tolerant fish species here suggests the effects of organic enrichment in this portion of Pumpkin Hollow Brook. Poorly buffered agricultural areas just upstream from the sampling reach are probably a major source of organic/nutrient inputs, while the upstream landfill may contribute pollutants as well.

In addition to water quality effects at PH00, habitat degradation appears to limit biological potential as well. Sediment deposition in pools and instream substrate embeddedness resulting from bank erosion and runoff at road crossings compromise both fish and macroinvertebrate habitat.

A thorough investigation of land-use practices in this subwatershed, and the need for BMP implementation or other controls of nonpoint source pollution, is recommended. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. Macroinvertebrate biomonitoring, which was not conducted here in 2000 due to limited resources, is recommended here during the next DEP Deerfield River watershed survey in 2005. In addition, water quality monitoring throughout the Pumpkin Hollow Brook subwatershed—especially nutrient and bacteria sampling—may help to isolate potential sources of nutrient/organic loads. Fish population sampling should again be conducted.

Green River

GR01

Benthos: “Non-impacted” compared to reference station.
Habitat: 76% comparable to reference station.

Despite the poorest habitat evaluation received by a Deerfield River watershed biomonitoring station, GR01 supported a surprisingly diverse and non-impacted benthic community. This bioassessment is dramatically different than the one received following the 1995 biosurvey conducted here, when filter-feeders tolerant of organic enrichment dominated the benthos assemblage and contributed to a “moderately impaired” assessment of biological condition. Nevertheless, the urbanized nature of this portion of the Deerfield River watershed continues to impact habitat quality (especially with riparian disturbances and instream deposition) and threaten biological potential at GR01. While it may be difficult to locate or isolate all sources of urban inputs, streambank stabilization and restoration of an adequate riparian zone may help to alleviate some nonpoint source inputs (e.g., road and parking lot runoff) associated with urban runoff in this portion of the river. In addition, a stream clean-up effort would address the trash deposits that compromise aesthetics here.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this low-gradient portion of the Green River, where both upstream agricultural activities and the urbanized nature of Greenfield potentially influence water quality and biological integrity. Fish population sampling, which has not historically been performed by DEP in the Green River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR01 sampling reach, the fish population survey may require multiple crews or a barge-mounted electrofishing unit.

GR02

Benthos: “Non-impacted” compared to reference station.
Habitat: 95% comparable to reference station.

GR02 was characterized by a healthy and non-impacted benthic macroinvertebrate community, with the highest number of pollution sensitive taxa (i.e., EPTs) of all the Deerfield River watershed biomonitoring stations. In fact, it is possible that biological integrity has improved here since DEP’s last biosurvey conducted in 1988, when slight impairment of the benthic community was detected.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this portion of the river, where its high-gradient nature dominates from here to the Vermont-Massachusetts border. Fish population sampling, which has not historically been performed by DEP at this station, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR02 sampling reach, fish population sampling should employ multiple crews or a barge-mounted electrofishing unit.

LDR01

Benthos: “Non-impacted” compared to reference station.
Habitat: 100% comparable to reference station.

Habitat and biological quality appear excellent here, as has historically been documented (MA DEP 1989, MA DEP 1997). Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this lower portion of the Deerfield River. Fish population sampling, which has not historically been performed by DEP in the Deerfield River, should accompany the macroinvertebrate sampling effort. Due to the extremely wide nature of the mainstem Deerfield River, fish population sampling will require multiple crews or a barge-mounted electrofishing unit.

LITERATURE CITED

Bain, M. B., and M. S. Meixler. 2000. Defining a target fish community for planning and evaluating enhancement of the Quinebaug River in Massachusetts and Connecticut. Final report by the New York Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY to the New England Interstate Water Pollution Control Commission, Lowell, MA. 51 p.

Barbour, M. T., J. B. Stribling, and J. R. Carr. 1995. The multimetric approach for establishing biocriteria and measuring biological condition. pp. 63-80. in W. S. Davis and T. P. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL. 415 p.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. Office of Water, US Environmental Protection Agency, Washington, DC. 151 p. + appendices

Bode, R. W., M. A. Novak, and L. E. Abele. 1991. Quality Assurance Work Plan for Biological Stream Monitoring in New York State. Stream Biomonitoring Unit, Division of Water, NYS Department of Environmental Conservation. Albany, NY. 78 p.

Bode, R. W. and M. A. Novak. 1998. Differences in environmental preferences of sister species of Chironomidae. 22nd Annual Meeting. New England Association of Environmental Biologists, Kennebunkport, ME. Stream Biomonitoring Unit, Division of Water, NYS Department of Environmental Conservation. Albany, NY.

EOEA. 1999. Deerfield River Watershed Monitoring Plan for 2000 (draft). Executive Office of Environmental Affairs (EOEA) Massachusetts Watershed Initiative (MWI) Deerfield River Basin Team. Greenfield, MA.

Fiorentino, J. F. 1997. 1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring. Technical Memorandum TM-33-1. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 24 p. + appendices

Fiorentino, J. F. 2002. 2000 Benthic Macroinvertebrate Biomonitoring Quality Assurance Project Plan. CN 38.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 58 p.

Franklin County. 2002. Franklin County Chamber of Commerce. http://www.co.franklin.ma/us/index.html. Last updated 21 October 2002.

Hall, R. J., G. E. Likens, S. B. Fiance, and G. R. Hendrey. 1980. Experimental acidification of a stream in the Hubbard Brook Experimental Forest, New Hampshire. Ecology 61: 976-89.

Halliwell, D.B, Langdon, R.W., Daniels, R.A., Kurtenbach, J.P., and R.A. Jacobson. 1999. Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications. pp. 301-338 in T. P. Simon (ed.). Assessing the Sustainability and Biological Integrity of water Resources Using Fish Communities. CRC Press, Boca Raton, FL. 671 p.

Hilsenhoff, W. L. 1982. Using a Biotic Index to Evaluate Water Quality in Streams. Technical Bulletin No. 132. Department of Natural Resources, Madison, WI.

Hughes, R. M. 1989. Ecoregional biological criteria. Water Quality Standards for the 21st Century. 1989: 147-151.

Johnson, R. K., T. Wiederholm, and D. M. Rosenberg. Freshwater biomonitoring using individual organisms, populations, and species assemblages of benthic macroinvertebrates. pp. 40-158. in. D. M.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. Special Publication 5. Illinois Natural History Survey. Champaign, IL. 28 p.

Lenat, D. R. 1993. A biotic index for the southeastern United States: derivation and list of tolerance values, with criteria for assigning water-quality ratings. J. N. Am. Benthol. Soc., 12(3): 279-290.

MA DEP. 1989. 1988 Deerfield River Basin Survey. Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch. Westborough, MA. 70 p.

MA DEP. 1996. Massachusetts Surface Water Quality Standards. Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch. Westborough, MA. 114p.

MA DEP. 1997. Draft Deerfield River Watershed 1995 Resource Assessment Report. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 43 p.

MA DEP. 1999. Massachusetts Section 303(d) List of Waters – 1998. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 129 p.

MA DEP. 2000. Commonwealth of Massachusetts Summary of Water Quality 2000. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP 2002a. Open NPDES permit files. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP 2002b. Standard Operating Procedures (Working Draft): Method 003/11.20.95 Fish Collection Procedures. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEQE. 1979. Deerfield River Basin 1977 Water Quality Analysis. Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control. Westborough, MA. 105 p.

Merritt, R. W., K. W. Cummins, and T. M. Burton. 1984. The role of aquatic insects in the processing and cycling of nutrients. pp. 134-163. in V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY. 625 p.

Minshall, G. W. 1984. Aquatic insect-substratum relationships. pp. 358-400 *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY. 625 p.

Novak, M. A. and R. W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. J. N. Am. Benthol. Soc., 11(4): 80-110.

Nuzzo, R. M. 1999a. Standard Operating Procedures (Working Draft): Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 8 p.

Nuzzo, R. M. 1999b. Hudson River Watershed (Kinderhook Creek and Hoosic River Subwatersheds) 1997 Biological Assessments. Technical Memorandum. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 25 p.

Peckarsky, B. L., P. R. Fraissinet, M. A. Penton, and D. J. Conklin, Jr. 1990. Freshwater macroinvertebrates of northeastern North America. Comstock Publishing Assoc. Ithaca, NY. 442 p.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89-001. Office of Water, US Environmental Protection Agency, Washington, DC.

Resh, V. H. 1988. Variability, accuracy, and taxonomic costs of rapid bioassessment approaches in benthic biomonitoring. Presented at the 36th annual North American Benthological Society meeting at Tuscaloosa, Alabama, 17-20 May 1988.

Rosenberg and V. H. Resh (eds.). 1993. Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman & Hall, New York, NY. 488 p.

Smith, M. E., B. J. Wyskowski, C. M. Brooks, C. T. Driscoll, and C. C. Crosentini. 1990. Relationships between acidity and benthic invertebrates of low-order woodland streams in the Adirondack Mountains, New York. Canadian Journal of Fisheries and Aquatic Sciences 47: 1318-29.

Tetra Tech, Inc. 1995. Massachusetts DEP Preliminary Biological Monitoring and Assessment Protocols for Wadeable Rivers and Streams. Method 003: Preliminary biological monitoring and assessment protocols for pulsed DC electrofishing. Prepared for Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 7 p.

US EPA. 1995. Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers. U.S. Environmental Protection Agency, Office of Water. 71 p.

USGS. 2002. Streamflow Measurement Data. [online]. United States Geological Survey. http://waterdata.usgs.gov/ma/nwis/help. Last updated 17 October 2002.

Wetzel, R. G. 1975. Limnology. W. B. Saunders Co., Philadelphia, PA. 743 p.

Wiederholm, T. 1984. Responses of aquatic insects to environmental pollution. pp. 508-557. *in.* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY. 625 p.

APPENDIX

Macroinvertebrate and fish taxa lists, RBPIII benthos analyses, and Habitat evaluations

Table A1. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2000 Deerfield River watershed survey between 25 and 27 September 2000. Refer to Table 1 for a complete listing and description of sampling stations.

Taxon	FG[1]	TV[2]	CR01[3]	VP11BEA[3]	DM00	GR01	GR02	LDR01	MB01	NOR01	NOR02A	PB01	SOR01	TB00	CH01
Ferrissia sp.	SC	6				1									
Nais alpina	GC	8											1		
Nais behningi	GC	6		1		1					1				
Nais communis	GC	8		1						3	1				
Lumbriculus variegatus	GC	5	1	2	2	1		3					4		1
Hydrachnidia	PR	6				2							1	2	
Baetidae	GC	4		3		2		3	3		1			4	
Baetis sp. (2 cerci)	GC	6		7		2		3	5	13		27	7		
Baetis sp. (subeq. term. filaments)	GC	6		10		2		4	8	3			5	6	
Baetidae (2 cerci)	GC	6					1				1				8
Baetidae (short terminal filament)	GC	6	3												
Baetidae (subeq. terminal filaments)	GC	6	1												
Caenis sp.	GC	6					1								
Ephemerellidae	GC	1	3				4	6		4			3	2	
Attenella sp.	GC	1				2					8				
Ephemerella sp.	GC	1				1	5			10	4	3	2		14
Eurylophella sp.	GC	2				1									
Serratella sp.	GC	2		12			3		10					21	
Heptageniidae	SC	4	1			1	1						2		
Epeorus sp.	SC	0	8	2			7	1	2		2	3	1	2	1
Rhithrogena sp.	GC	0		12			1	5		7			3	1	2
Stenonema sp.	SC	3				1	7				1				
Isonychia sp.	GC	2				4	10	5		3	1	2	1		
Leptophlebiidae	GC	2					1				3				1
Leptophlebia sp.	GC	4	4												
Paraleptophlebia sp.	GC	1		5						1		3	2		
Ophiogomphus sp.	PR	1					1								
Allocapnia sp.	SH	3													1
Sweltsa sp.	PR	0	2	4	7				25	1		16		4	
Leuctra sp.	SH	0					1								
Paraleuctra sp.	SH	0							1			1			
Leuctridae/Capniidae	SH	2		1											
Tallaperla sp.	SH	0		1					1						
Perlidae	PR	1		1							1		1		
Acroneuria sp.	PR	0				1	1							1	
Agnetina sp.	PR	2	1										1	1	1
Hansonoperla sp.	PR	1										2			
Neoperla sp.	PR	3					1								
Paragnetina sp.	PR	1	1										1	2	
Perlodidae	PR	2		1		2									
Diura sp.	PR	2										1			
Isogenoides sp.	PR	0											1		
Isoperla sp.	PR	2	3							3		4	1	2	5

Table A1 (cont.)

Taxon	**FG**[1]	**TV**[2]	**CR01**[3]	**VP11BEA**[3]	**DM00**	**GR01**	**GR02**	**LDR01**	**MB01**	**NOR01**	**NOR02A**	**PB01**	**SOR01**	**TB00**	**CH01**
Pteronarcys sp.	SH	0												1	1
Nigronia sp.	PR	0					1							1	
Micrasema sp.	SH	2						1							
Glossosoma sp.	SC	0	2	1		13	1	4			3	1			
Helicopsyche borealis	SC	3									1				
Cheumatopsyche sp.	FC	5	5			3	12	1		2			1		3
Diplectrona sp.	FC	0							1					2	
Hydropsyche morosa gr.	FC	6	11	5		6	5	15	3	6	6	5	14	7	15
Lepidostoma sp.	SH	1	1				1	2		1		2		2	1
Pycnopsyche sp.	SH	4			1										
Chimarra sp.	FC	4						5							
Dolophilodes sp.	FC	0	7	6			2	1	4		3	7	4	3	8
Polycentropus sp.	PR	6			1		1								
Rhyacophila sp.	PR	1	2	3	2					1	1	4	1	4	
Optioservus sp.	SC	4				11	2			2	1		6		
Optioservus ovalis	SC	4		1											
Oulimnius latiusculus	SC	4						4	1			1			
Promoresia sp.	SC	2						1							
Stenelmis sp.	SC	5	1			5	1	2							
Stenelmis crenata gr.	SC	5						1					1		
Psephenus herricki	SC	4				2	1	1					1		
Diptera	na	na			1										
Atherix sp.	PR	4		1										1	
Probezzia sp.	PR	6	1		1						1		2	1	1
Stilobezzia sp.	PR	6											1		1
Chironomus sp.	GC	10									2			1	
Cryptochironomus sp.	PR	8				1				1					
Einfeldia sp.	GC	9								1					
Microtendipes pedellus gr.	FC	6				1				1			1		
Microtendipes rydalensis gr.	FC	6										1			
Polypedilum angulum	SH	6		1	3				1		1			2	
Polypedilum aviceps	SH	4	17	4			13	5	1	14	12		10	2	20
Polypedilum flavum	SH	6	1			5	1	6		2	14				
Polypedilum scalaenum	SH	6									1				
Cladotanytarsus sp.	FC	5				1				1					
Micropsectra sp.	GC	7		1	1					3	1			4	1
Rheotanytarsus sp.	FC	6						4							
Rheotanytarsus distinctissimus gr.	FC	6	5			4		6		1	6	1	1		
Rheotanytarsus exiguus gr.	FC	6				1		2							
Tanytarsus sp.	FC	6		1		1					1				
Brillia sp.	SH	5			9									1	
Cardiocladius sp.	PR	5				1				1	1				
Chaetocladius sp.	GC	6										1			
Corynoneura sp.	GC	4	3	1		1						1			
Cricotopus sp.	SH	7											1		
Eukiefferiella sp.	GC	6	1							2					
Eukiefferiella brehmi gr.	GC	4	1												
Eukiefferiella brevicalcar gr.	GC	4												2	
Eukiefferiella claripennis gr.	GC	8		2	2	2			17	1		1	1	3	1
Eukiefferiella devonica gr.	GC	4								2					
Lopescladius sp.	GC	4		1			3			1	2		7		
Metriocnemus sp.	GC	5	2												

Table A1 (cont.)

Taxon	**FG**[1]	**TV**[2]	**CR01**[3]	**VP11BEA**[3]	**DM00**	**GR01**	**GR02**	**LDR01**	**MB01**	**NOR01**	**NOR02A**	**PB01**	**SOR01**	**TB00**	**CH01**
Nanocladius sp.	GC	7													1
Orthocladius sp.	GC	6				2		4							1
Parachaetocladius sp.	GC	2		1										1	
Parametriocnemus sp.	GC	5	1			1			2	2	2				
Psilometriocnemus sp.	GC	4			1										
Synorthocladius sp.	GC	6				1									
Thienemanniella sp.	GC	6					1	1	1						
Tvetenia sp.	GC	5				1		1			1				
Tvetenia bavarica gr.	GC	5		8	2		1		6	1	4	6	5	2	5
Tvetenia vitracies gr.	GC	5	1				1	1			3				
Conchapelopia sp.	PR	6						1		1					
Pentaneura sp.	PR	6	1												
Thienemannimyi a sp.	PR	6				1									
Chelifera sp.	PR	6													1
Clinocera sp.	PR	6												1	
Hemerodromia sp.	PR	6				2					1		1	1	
Simulium sp.	FC	5		1		3		1	1				2	1	
Antocha sp.	GC	3				1				2			2		
Dicranota sp.	PR	3				2								1	
Hexatoma sp.	PR	2	1	1			1	1	3						1
Molophilus sp.	SH	3			1										
Pseudolimnophila sp.	SH	3			1										

[1]Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.

[2]Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.

[3] Reference station

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Deerfield River watershed survey between 25 and 27 September 2000. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Cold River reference station (CR01), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**CR01**		**CH01**		**NOR01**		**NOR02A**		**GR01**		**GR02**		**SOR01**		**LDR01**	
STREAM	Cold River		Chickley River		North River		E. Branch North River		Green River		Green River		South River		Deerfield River	
HABITAT SCORE	178		163		187		190		135		169		170		192	
TAXA RICHNESS	29	*6*	24	*6*	30	*6*	31	*6*	38	*6*	30	*6*	34	*6*	28	*6*
BIOTIC INDEX	3.48	*6*	3.61	*6*	4.02	*6*	4.13	*4*	4.09	*6*	3.01	*6*	4.16	*4*	4.18	*4*
EPT INDEX	16	*6*	13	*4*	12	*2*	13	*4*	12	*2*	18	*6*	16	*6*	13	*4*
EPT/CHIRONOMIDAE	1.67	*6*	2.10	*6*	1.57	*6*	0.71	*2*	1.71	*6*	3.30	*6*	1.96	*6*	1.81	*6*
SCRAPER/FILTERER	0.43	*6*	0.04	*0*	0.18	*4*	0.50	*6*	1.70	*6*	1.05	*6*	0.48	*6*	0.40	*6*
% DOMINANT TAXON	18%	*6*	21%	*4*	14%	*6*	15%	*6*	14%	*6*	14%	*6*	14%	*6*	15%	*6*
REFERENCE AFFINITY	100%	*6*	92%	*6*	76%	*6*	78%	*6*	72%	*6*	73%	*6*	78%	*6*	85%	*6*
TOTAL METRIC SCORE		*42*		*32*		*36*		*34*		*38*		*42*		*40%*		*38*
% COMPARABILITY TO REFERENCE	100%		76%		86%		81%		90%		100%		95%		90%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY IMPACTED**		**NON-IMPACTED**		**NON/ SLIGHTLY IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**	

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Deerfield River watershed survey between 25 and 27 September 2000. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Bear River reference station (VP11BEA), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	VP11BEA		PB01		MB01		DM00		TB00		CH01		SOR01	
STREAM	Bear River		Pelham Brook		Mill Brook		Davis Mine Brook		Taylor Brook		Chickley River		South River	
HABITAT SCORE	176		187		181		174		157		163		170	
TAXA RICHNESS	31	*6*	22	*4*	19	*4*	15		32	*6*	24	*4*	34	*6*
BIOTIC INDEX	3.15	*6*	3.05	*6*	3.49	*6*	3.94[1]		3.27	*6*	3.61	*6*	4.16	*4*
EPT INDEX	15	*6*	15	*6*	10	*0*	4		15	*6*	13	*4*	16	*6*
EPT/CHIRONOMIDAE	3.70	*6*	7.36	*6*	2.25	*4*	0.61		3.61	*6*	2.10	*4*	1.96	*4*
SCRAPER/FILTERER	0.31	*6*	0.36	*6*	0.33	*6*	None Present		0.15	*4*	0.04	*0*	0.48	*6*
% DOMINANT TAXON	12%	*6*	29%	*4*	26%	*4*	26%		23%	*4*	21%	*4*	14%	*6*
REFERENCE AFFINITY	100%	*6*	76%	*6*	69%	*6*	46%		84%	*6*	74%	*6*	74%	*6*
TOTAL METRIC SCORE		*42*		*38*		*30*				*38*		*28*		*38*
% COMPARABILITY TO REFERENCE	100%		90%		71%		Not Valid[2]		90%		67%		90%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE***		**NON-IMPACTED**		**SLIGHTLY IMPACTED**		**SEVERELY IMPACTED[3]**		**NON-IMPACTED**		**SLIGHTLY IMPACTED**		**NON-IMPACTED**	

*Primary reference for PB01, MB01, DM00, and TB00; Secondary reference for CH01 and SOR01.

[1]Does not include undetermined dipteran tolerance value.

[2]Direct comparisons to reference station metrics invalid due to low (<100 organisms) subsample number.

[3]Based on best professional judgement and supporting fish data (fish absent).

Table A4. Habitat assessment summary for biomonitoring stations sampled during the 2000 Deerfield River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	VP11BEA*	CR01*	DM00	CH01	MB01	NOR01	NOR02A	SOR01	PH00	PB01	LDR01	GR01	GR02	TB00
PRIMARY PARAMETERS (range is 0-20)	**SCORE**													
INSTREAM COVER	18	17	18	19	19	19	19	17	15	19	19	16	11	17
EPIFAUNAL SUBSTRATE	19	20	18	18	20	20	20	17	18	20	20	19	20	18
EMBEDDEDNESS	20	18	19	17	19	17	20	15	7	20	20	12	20	18
CHANNEL ALTERATION	20	20	19	18	20	20	20	17	19	20	20	17	14	20
SEDIMENT DEPOSITION	18	18	16	13	18	15	17	13	7	19	20	17	17	7
VELOCITY-DEPTH COMBINATIONS	15	16	17	19	19	20	18	15	16	19	15	18	13	13
CHANNEL FLOW STATUS	16	16	16	9	16	19	19	17	15	18	18	13	18	8
SECONDARY PARAMETERS (range is 0-10 for each bank)	**SCORE**													
BANK VEGETATIVE PROTECTION left right	10 9	9 10	10 10	10 10	10 9	10 10	10 10	10 10	9 8	10 10	10 10	6 3	10 9	10 10
BANK STABILITY left right	10 7	8 10	9 10	8 4	5 5	10 9	10 9	10 9	6 9	9 9	10 10	3 5	10 9	10 8
RIPARIAN VEGETATIVE ZONE WIDTH left right	10 4	6 10	2 10	10 10	10 10	10 8	8 10	10 10	9 8	5 9	10 10	3 3	8 10	8 10
TOTAL SCORE	176	178	174	165	180	187	190	170	146	187	192	135	169	157

*Reference station

Table A5. Fish population data collected by DWM at nine biomonitoring stations in the Deerfield River watershed between 26 and 28 September 2000. Sampling stations were at: Pelham Brook (PB01); Cold River (CR01); Chickley River (CH01); Mill Brook (MB01); Davis Mine Brook (DM00); Taylor Brook (TB01); Pumpkin Hollow Brook (PH00); East Branch North River (NOR02A); and South River (SOR01). Refer to Table 1 for a complete listing and description of sampling stations.

TAXON		Habitat Class[1]	Trophic Class[2]	Tolerance Class[3]	PB01	CR01	CH01	PH00	MB01	DM00	TB00	SOR01	NOR02A
common shiner	*Luxilus comutus*	FDR	GF	M	-	-	-	85	-	-	-	7	-
blacknose dace	*Rhinichthys atratulus*	FS	GF	T	5	29	5	60	3	-	*	29	3
longnose dace	*Rhinichthys cataractae*	FS	BI	M	26	4	7	2	-	-	*	7	4
creek chub	*Semotilus atromaculatus*	MG	GF	M	-	-	-	165	-	-	-	6	-
white sucker	*Catostomus commersoni*	FDR	GF	T	-	-	-	-	-	-	*	-	-
longnose sucker	*Catostomus catostomus*	MB	BI	I	-	-	-	-	-	-	*	-	-
yellow bullhead	*Ameiurus natalis*	MG	GF	T	-	-	-	-	-	-	-	-	1
Atlantic salmon	*Salmo salar*	FS	TC	I	22	39	19	2	38	-	-	13	20
brown trout	*Salmo trutta*	FS	TC	I	1	1	3	-	-	-	-	-	-
brook trout	*Salvelinus fontinalis*	FDR	TC	I	7	-	-	1	14	-	*	-	-
rainbow trout	*Onchorynchus mykiss*	FDR	TC	I	-	-	2	-	-	-	-	-	-
banded killifish	*Fundulus diaphanous*	MG	WC	T	-	-	-	-	-	-	-	-	1
tessellated darter	*Etheostoma olmstedi*	FS	BI	M	-	-	-	-	-	-	-	-	1
slimy sculpin	*Cottus cognatus*	FS	BI	I	33	-	8	-	-	-	-	-	-

[1] Habitat Class - FS (fluvial specialist), FDR (fluvial dependant reproduction), MG (macrohabitat generalist). From Bain and Meixler (2000), modified for Massachusetts

[2] Trophic Class - GF (generalist feeder), BI (benthic invertivore), TC (top carnivore), WC (water column invertivore). From Halliwell et al. (1999)

[3] Tolerance Classification - I (intolerant), M (moderately tolerant), T (tolerant). From Halliwell et al. (1999)

* species was present, but numbers unknown due to loss of field sheets

APPENDIX C

Technical Memorandum TM-33-1

1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring

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INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts on the aquatic community. Resident biota (e.g. benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic as well as cumulative pollution and habitat alteration (Plafkin et al. 1989, Barbour et al. 1995). Biological surveys and assessments are the primary approaches to biomonitoring.

Robert Nuzzo and I conducted biomonitoring based on United States Environmental Protection Agency Rapid Bioassessment Protocols (USEPA RBP) at 6 sites requested by the Massachusetts Department of Environmental Protection (MADEP) Deerfield River Basin Team as part of the 1995 watershed survey. A biosurvey, which focused on the standardized sampling of benthic macroinvertebrates, was supplemented with a habitat assessment to evaluate water quality and habitat quality at each study site. In addition, the basin team conducted monthly trend monitoring over a twelve month period at these stations (and one other) for general water quality variables, metals, nutrients, and bacteria. The sampling sites were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts. All of these sites, with the exception of BR01, were sampled during a previous biomonitoring survey conducted in this watershed by DEP (Macroinvertebrate Rapid Bioassessment, or MRB survey, 1988). Results of the 1988 survey will be discussed briefly, with particular emphasis placed on those stations sampled again in 1995. While a direct comparison of 1988 and 1995 stations is inadvisable, it will at least be possible to determine whether biological integrity has improved or worsened at a site over time. Data from those sites in the 1988 survey not sampled in 1995 will be presented only in tabular form.

METHODS

Macroinvertebrate biomonitoring was conducted at 6 stations during the 1995 survey, as described in Table 1 and noted in Figure 1. A total of 10 stations, also described in Table 1, were sampled during the 1988 survey. The macroinvertebrate collection procedure utilized kick sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms downstream with an aquatic net. Sampling was conducted in riffle/run areas with fast currents and cobble and gravel substrates--generally the most productive habitats, supporting the most diverse communities in the stream system. A kick net with an opening approximately 0.45 m wide and a mesh size of 590 microns was used to collect a sample from an approximately 1 m^2 area. Two 1 m^2 samples were collected at each station--one from an area of fast current velocity and one from an area of slower current velocity. The two samples were then composited in the field and preserved with 95% ethanol before processing.

Table 1. Biomonitoring station locations in the 1988/1995 Deerfield River basin survey

Station	Station Description	Survey date
UDR01	Deerfield River (upper) Upstream from Florida Bridge/Zoar Road Florida-Charlemont, Massachusetts	26 September 1995 18 July 1988
LDR01	Deerfield River (lower) Downstream from Stillwater Bridge, Deerfield, Massachusetts	28 September 1995 19 July 1988
LDR02	Deerfield River (lower) At Route 2 (and USGS guage) Charlemont, Massachusetts	19 July 1988
NOR01	North River Upstream from Route 112 Colrain, Massachusetts	26 September 1995 19 July 1988
NOR02	North River-East branch At Elm Grove off Route 112 Colrain, Massachusetts	19 July 1988
SOR01	South River Upstream from Reeds Bridge Road Conway, Massachusetts	28 September 1995 20 July 1988
SOR02	South River At Emmet's Road Ashfield, Massachusetts	20 July 1988
GR01	Green River Downstream of footbridge off Route 5-10 Greenfield, Massachusetts	28 September 1995 19 July 1988
GR02	Green River At Green River Road Greenfield, Massachusetts	20 July 1988
CR01	Cold River At entrance to Mohawk State Forest Charlemont, Massachusetts	18 July 1988
BR01	Bear River Upstream from Shelburne Falls Road Conway, Massachusetts	26 September 1995

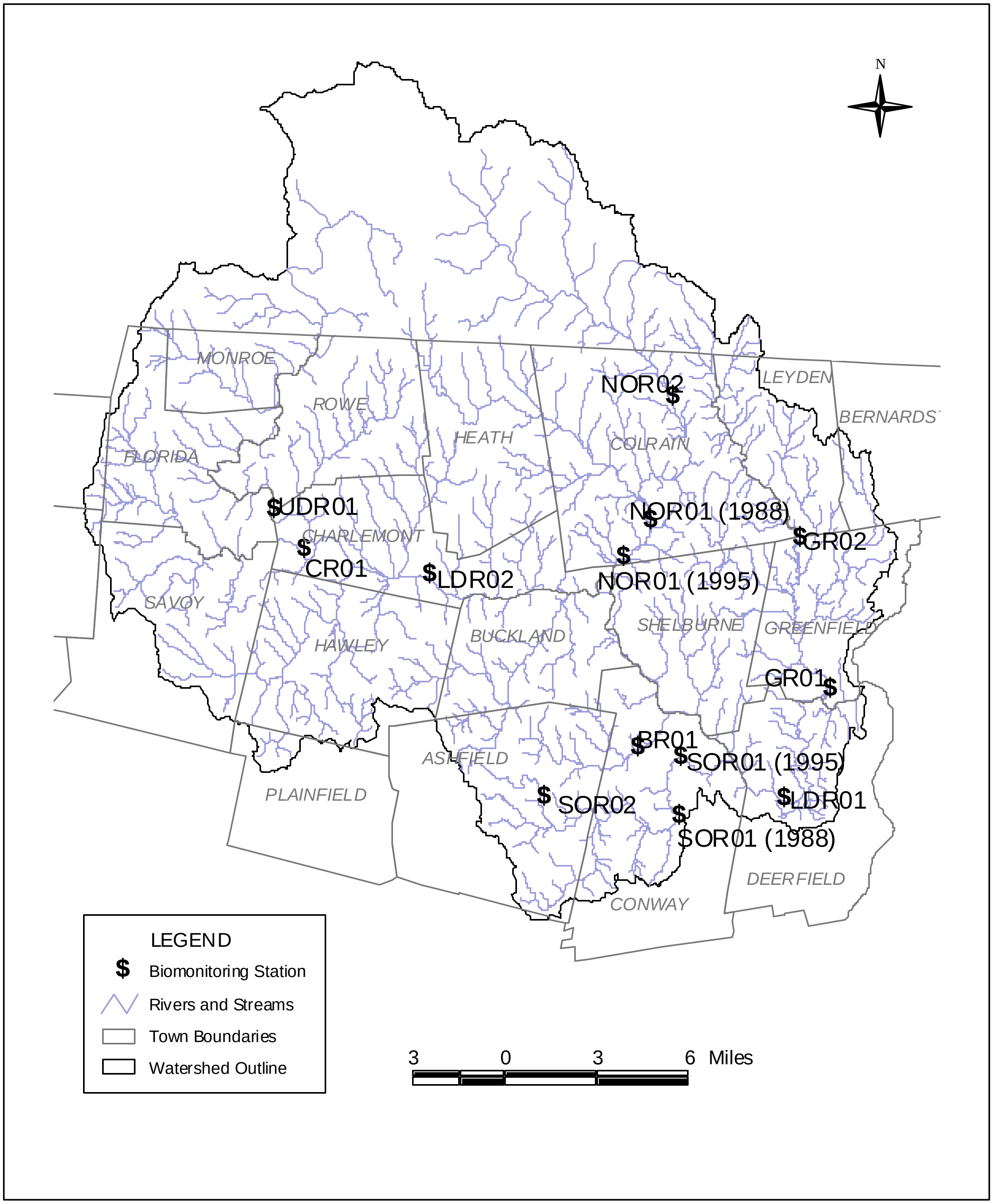

Figure 1. Location of biomonitoring stations for the 1998 and 1995 Deerfield River Watershed survey.

In the laboratory, a 100 macroinvertebrate randomized subsample was separated from the original sample collected at each site, and specimens were identified to family (Rapid Bioassessment Protocol II, or RBP II) to the extent their condition allowed. Based on this family-level taxonomy, various community, population, and functional parameters, or "metrics," are calculated which allow us to measure important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Plafkin et al. 1989). The percent comparability of study site metric scores to those for a selected unimpaired reference station (i.e. "best attainable situation") yields an impairment score for each site. RBP II analysis separates sites into three categories: non-impaired, moderately impaired, and severely impaired. Impairment of the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Plafkin et al. 1989).

RBP II also utilizes a habitat assessment matrix for rating habitat quality, an integral component in the final evaluation of impairment. The habitat assessment is intended to support the biosurvey and enhance the interpretation of the biological data. The matrix used to assess habitat quality is based on key physical characteristics of the water body and surrounding land use. All parameters evaluated are related to overall land use and are potential sources of limitation to the aquatic biota (Plafkin et al. 1989). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, velocity/depth combinations, channel alteration, bottom scouring and deposition, pool/riffle ratio, right and left (when facing downstream) bank vegetative stability, right and left bank stability, streamside cover. The habitat parameters included in the matrix were evaluated at all sites sampled in the Deerfield River Basin. Ratings were then totaled and compared to a regional and/or upstream reference station to provide a final habitat ranking. Sites receive one of four possible habitat evaluations: comparable to reference conditions, supporting, partially supporting, and non-supporting.

It is important to recognize that Rapid Bioassessment Protocol II is primarily a semi-quantitative screening tool which allows users to evaluate a large number of sites with relatively limited time and effort. The protocol is best used to prioritize sites for more intensive evaluation, such as RBP III, toxicity testing, or quantitative replicate sampling. The information derived from RBP II provides a basis for ranking sites as non, moderately, or severely impaired. This classification can then be used to focus on additional study or remediation (e.g., regulatory action).

Two of the study sites investigated in the 1995 Deerfield River Basin survey received RBP II scores indicating moderate impairment (Appendix A: Table 3). Because this category offers a wide-ranging and somewhat ambiguous assessment, it was my recommendation that more information be gathered on the aquatic invertebrate assemblage at these stations. This was achieved by applying Rapid Bioassessment Protocol III (RBP III), a more rigorous bioassessment technique than RBP II, which allows detection of more subtle degrees of impairment. By increasing the level of taxonomic resolution; that is, by performing taxonomic identification to the lowest practical level, the ability to discriminate the level of impairment is enhanced. While this additional taxonomy (species-level identification) requires considerably more time, discrimination of four levels of impairment--non, slight, moderate, and severe--becomes possible following recalculation of the metrics.

RESULTS & DISCUSSION

1995 Biosurvey:

The taxonomic list of macroinvertebrates obtained from subsamples taken from each site is attached as an appendix (Appendix A). Table A1 includes the family-level taxonomic list of macroinvertebrates from all sites sampled, while Table A2 is a species-level taxonomic list of macroinvertebrates obtained from those sites that scored moderately impaired following RBP II analysis. Included in both taxa lists are total organism counts, and the functional feeding group (FFG) and tolerance value (TV) of each taxon.

Summary tables of the RBP data analyses, including biological metric calculations, metric scores, and impairment scores, are also included in the appendix. Table A3 is the summary table for all sites when RBP II analysis is applied. Table A4, the RBP III data analysis summary, includes metric calculations and impairment scores for those stations which were found to be moderately impaired following RBP II analysis. Habitat assessment scores for each station are also included in the summary tables.

1988 Biosurvey:

Data compiled from the 1988 biosurvey are attached as Appendix B. As samples collected from the 1988 survey were speciated (RBPIII), Table B1 is a species-level taxonomic list of macroinvertebrates. Included in the taxa list are total organism counts, and the functional feeding group (FFG) and tolerance value (TV) of each taxon.

Summary tables of the RBP data analyses, including biological metric calculations, metric scores, and impairment scores, are also included in the appendix. Table B2 is the RBP analysis table when using DE06 as the regional reference station for all sites. Table B3 is the data analysis summary for those stations being compared to an upstream reference station (DE05A, DE10, DE15, or DE16).

BR01--Bear River, Conway, MA (26 September 1995)

HABITAT

The BR01 sampling reach began approximately 100 m upstream from Shelburne Falls Road and meandered through a heavily wooded hemlock forest. This portion of the stream was approximately 2 m wide and 0.25 m deep. Well developed riffle areas with a variety of stable hard substrates offered exceptional habitat for fish, and especially, invertebrates. Dense bryophyte cover on much of the rock substrates provided additional productive microhabitat for macroinvertebrates. Embeddedness and deposition were virtually nonexistent. Bank stability was excellent, and the dense forest on both sides of the stream provided an unlimited and undisturbed riparian vegetative zone throughout the reach. BR01 received a total habitat assessment score of 123 out of a possible 135. Sampling was confined to the rocky substrates--cobble/gravel and boulder--which were predominant throughout the reach. Those larger boulders which would not move required gentle hand-rubbing to remove attached organisms.

BR01 was designated a regional reference station for the Deerfield River Basin by virtue of its high habitat evaluation, and minimal upstream and surrounding land use impacts (e.g., absence of point source inputs, lack of nearstream agriculture and channelization activity, minimal development, undisturbed riparian zones with woody vegetation, lack of other anthropogenic impacts) relative to the overall watershed. As a third/fourth order stream, BR01 served as a primary reference station for those study sites in streams with a comparable drainage area (NOR01, SOR01, GR01); however, the lower Deerfield River station LDR01--a fifth order stream--required an upstream control (UDR01), offering a more comparable drainage area. Differences in riparian and instream characteristics also made comparisons between BR01 (partially closed canopy, shredder/particulate organic matter-dominated) and LDR01 (open canopy, grazer/periphyton dominated) inappropriate.

Since both the quality and quantity of available habitat affect the structure and composition of resident biological communities, effects of such features can be minimized by sampling similar habitats at all stations being compared (Plafkin et al. 1989). Sampling highly similar habitats will also reduce metric variability, attributable to factors such as current speed and substrate type. Furthermore, unless basically similar physical habitat is sampled at all stations, community differences attributed to a degraded habitat will be difficult to separate from those resulting from water quality degradation. The discrepancy in habitat, then, between BR01 and the Deerfield River stations would probably be reflected in the invertebrate assemblages found there as well; however, it would be impossible to determine whether water quality or habitat quality is limiting to the biological integrity of the study site. Habitat and benthos descriptions for Deerfield River biomonitoring stations will be discussed later.

BENTHOS

The family level and species level taxonomic list of macroinvertebrates collected at BR01 can be found in Tables A1 and A2 respectively. Because BR01 is a reference station, it does not receive an impairment score for the aquatic community found there. However, the metric values (Tables A3 and A4) calculated as part of the RBP analyses reflect the healthy benthic community one would expect to find in a "least impacted" stream. In particular, those parameters that measure components of community structure (taxa richness, biotic index, and EPT index)--which dsplay the lowest inherent variability among the RBP metrics used (Resh 1988)--scored well and corroborate the designation as a reference station. BR01 received a total metric score of 42 out of a possible 42 following both RBP analyses. This station was not sampled during the 1988 biosurvey.

NOR01--North River, Colrain, MA (26 September 1995)

Sampling was conducted at NOR01 to investigate possible water quality degradation effects originating from Veratec Incorporated (NPDES # MA0003697), a division of International Paper located approximately 2000 m upstream from the sampling reach. Formerly permitted as Kendall Company, Veratec is currently engaged in the manufacturing of non-woven products (e.g. cleaning wipes and pads, milk filters, coverstock for diapers and feminine hygiene products, industrial grade fabrics); the bleaching of cotton and gauze fibers, and woven/knitted fabrics; and the dyeing of woven/knitted fabrics. In addition, the facility treats the sanitary waste from nearby residences. There are two discharges from the Veratec plant: 1) The biological waste water (comprised of the process wastewater as well as the sanitary wastewater from the nearby residences) treatment system discharge (004) and 2) The Filter Backwash discharge (005). Of particular interest, is the presence of lead, silver, ammonia, and chlorine in the Veratec effluent--all which potentially threaten biological integrity downstream of the discharge. Furthermore, the very low hardness in the receiving portion of the North River indicates that this portion of the river may be particularly sensitive to these and other discharged pollutants.

HABITAT

NOR01 was located approximately 100 m upstream of Route 112 and about 1000 m upstream of the confluence with the Deerfield River. Here the stream was approximately 5 m wide and 0.5 m deep. The sampling reach meandered through a hemlock-dominated forest that was especially dense along the left bank of the channel. The right bank, consisting of a profusion of flood plain vegetation, was fairly well buffered from the road (approximately 50 m away). During heavy rain, road runoff is diverted to the river from the road via a drainage ditch, which enters the river below the sampling reach. Here substantial deposits of sand were observed both instream and along the right bank, where a small "beach" has developed (although some of this sand may be naturally occurring flood plain soil). The dramatic series of rapids throughout the NOR01 reach provided macroinvertebrates with excellent habitat, with an abundance of rock substrates (cobble and boulder) and a variety of velocity/depth combinations. Deep riffles and pools, with occasional submerged logs, offered stable cover for fish as well. Substrate embeddedness and sediment deposition were virtually nonexistent, as were signs of channel alteration. Although a few small areas of erosion were observed along the stream banks, bank vegetative stability and streamside cover were very good. NOR01 received a habitat assessment score of 123, which was highly comparable to the "best attainable" conditions of the regional reference station BR01. Since habitat quality is similar at both sites, detected impacts--if any--at the NOR01 study site, can be attributed to water quality factors.

BENTHOS

NOR01 received a total metric score of 33, representing a 92% comparability to reference conditions and placing the study site in the non-impaired category for biological integrity (Table A3). In fact, most metrics--including those for richness (taxa richness, EPT index), which generally increase with increasing water quality--scored better than all other study sites in the survey (Table A3). Thus, a diverse macroinvertebrate assemblage dominated by intolerant forms, coupled with a low biotic index (3.18), indicates both a balanced trophic structure and optimum community structure, precluding the presence of organic or toxic pollutants in this portion of the North River.

It appears, then, that discharge loads from Veratec Incorporated are assimilated by the North River before impacts are seen in the benthic community downstream, as reflected by the healthy macroinvertebrate community found there. It should be noted, however, that dramatic color change has been observed at NOR01 by members of the Deerfield River Basin Team during routine monthly (July and August 1995) water quality surveys. Dark reddish brown discharges originating from Veratec, while apparently not impacting the macroinvertebrate community, may pose a threat to the fish population along this portion of the river. As fish rely heavily on visual stimuli, temporal changes in water color may have pronounced effects on activities such as foraging.

1988

The 1995 NOR01 station was sampled during the 1988 biomonitoring survey as well. To bracket the effects of the Veratec discharge, NOR01 was compared to an upstream reference station (site-specific control) representative of the "best attainable" conditions in the waterbody. This alternative to the regional reference site approach is recommended when assessing a known impact site (Plafkin et al. 1989). NOR02, the upstream control, was located in the East Branch North River near the Route 112 Bridge in Colrain, approximatly 4000 m upstream of Veratec Incorporated. NOR01 received a total metric score of 32, representing an 84% comparability to the upstream control and placing the study site in the non-impaired category for biological integrity (Table B3). In fact, several of the metrics (biotic index, EPT index, EPT/Chironomidae, scraper/filterer) for the NOR01 invertebrate assemblage scored as well as, or better than, those of the reference site. It should also be noted that a comparison to the regional reference site found the aquatic community of NOR02 to be non-impaired. A total metric score of 36 was 86% comparable to "least impacted" conditions (Table B2) in the Cold River, corroborating the use of NOR02 as an upstream reference station for NOR01.

The macroinvertebrate community at NOR01 was also compared to a regional reference station in the Cold River during the 1988 survey. CR01 was located in the Mohawk Trail State Forest just above the confluence with the Deerfield River in Charlemont, and received minimal anthropogenic influence, thus, serving as a good regional reference site for all biomonitoring stations in the 1988 survey. When using the CR01 station as a reference site, NOR01 received a total metric score of 30, representing a 71% comparability to reference conditions and placing the benthic community in the slightly impaired category (Table B2). While the evaluation suffered slightly when using CR01 as a reference (as opposed to when compared to the site-specific control), several metrics did score better than those for reference conditions--biotic index, EPT/Chironomidae, and scraper/filterer.

Regardless, of which reference station is used, it appears that the discharge effects of Veratec Incorporated had only a minimal--if any--impact on the downstream macroinvertebrate community in 1988. Water/habitat quality degradation, and subsequent benthos impairment, was even less evident at this site in 1995, when biological integrity was found to be highly comparable to reference conditions.

SOR01--South River, Conway, MA (28 September 1995)

SOR01 was located in the South River, a third order stream, approximately 2500 m upstream from the confluence with the Deerfield River. Sampling was conducted to investigate a variety of anthropogenic impacts originating upstream--most notably, failed septic systems in the vicinity of Conway and Ashfield (most homes are situated close to the river), and agricultural activities adjacent to much of the river between Conway and the sampling station.

HABITAT

This portion of the South River was approximately 5-10 m wide with a depth of 0.25 m. Kick samples were taken from both fast and slower riffles approximately 50 m upstream of Reeds Bridge Road, where the stream meandered through a forest of hemlock and mixed hardwoods (sugar maple, birch, hickory).

Shrubs (witch hazel) and grasses were abundant along the left bank as well. Substrates were dominated by cobble and gravel; however, macroinvertebrate microhabitat seemed somewhat reduced due to substrate embeddedness. A lack of velocity/depth combinations, particularly deep areas, further reduced the quality and diversity of benthic habitat. The deposition of sand--especially in pools--coupled with a lack of stable cover in pools and riffles, provided fish with only fair habitat and cover. A considerable amount of sand had also been deposited along the left bank (just below the sampling reach), probably the result of road runoff from Reeds Bridge Road. Riparian and bank structure were good--banks were well stabilized with vegetation and boulders, with only occassional areas of erosion observed.

SOR01 received a habitat assessment score of 79, which was only 64% comparable (assessment category= "partially supporting") to habitat at the Bear River station. This was the lowest habitat evaluation received by a biomonitoring station in the Deerfield River Basin survey.

BENTHOS

SOR01 received a total metric score of 24 following RBP II analysis. This represents a 57% comparability to the regional reference station, placing the aquatic community in the moderately impaired category (Table A3). The EPT index--which generally increases with increased water quality--scored particularly poorly (score=0), as did the community similarity metric (score=0). Because of the ambiguity of the overall impairment score, RBP III analysis was completed to improve the resolution of the impairment range and increase the reliability of the assessment. Following recalculation of biological metrics based on genus/species level taxonomy, SOR01 received a total metric score of 20, representing a 48% comparability to the reference site. Again, this placed the SOR01 macroinvertebrate community in the moderately impaired category (Table A4).

Due to the very low habitat comparability to the BR01 reference site, it is difficult to determine whether habitat constraints or water quality factors are limiting to biological integrity at SOR01. While biological effects may be due to a combination of water quality and habitat degradation, the use of physicochemical data and water quality data collected by the Deerfield River Basin Team should aid in the interpretation of the biomonitoring data.

1988

The lower portion of the South River (SOR01) was sampled during the 1988 biosurvey; however, sampling was conducted approximately 2500 m upstream from the 1995 SOR01 station, where Reeds Bridge Road again crosses the river. The SOR01 station was compared to both the regional reference station CR01, and an upstream reference station (SOR02) located at Emmet's Road in Ashfield. Regardless of which reference was used, SOR01 received a total metric score of 28, representing a 67% comparability to "best attainable" conditions and placing the aquatic community in the slightly impaired category for biological integrity (Tables B2 and B3).

While it is difficult to determine the primary cause of impairment, it appears that biological integrity has been slightly degraded in the lower South River since 1988. Likely causes of habitat degradation, particularly sediment deposition and subsequent microhabitat depletion, are runoff from nearby Shelburne Falls Road/Bardwell Road and additional sediment erosion from upstream agricultural activities--especially along the flood plain in areas lacking adequate vegetative buffers. In addition, the presence of a small dam structure (Kimball, MADEP, personal communication) just upstream of SOR01 may result in scouring and subsequent deposition in the sampling reach. Sedimentation at SOR01 may contribute to the lack of EPT taxa and overall species richness, as studies have demonstrated that the primary effect of sediment addition to a stream is to initiate drift of animals from the affected site (Wiederholm 1984). Agricultural practices and associated runoff (e.g. pesticides, fertilizers, organic inputs) are also potential sources of water quality degradation, as are failing septic systems in the vicinity of Ashfield and Conway. It is imperative that macroinvertebrate sampling be conducted at SOR01 during future basin surveys, as construction of the Ashfield Treatment Plant (NPDES #MA0100749)--an alternative tertiary waste treatment facility--was completed in 1996.

GR01--Green River, Greenfield, MA (28 September 1995)

GR01 was located downstream of downtown Greenfield and a number of potential water quality stressors associated with its urban setting. Urban runoff and industrial activities have historically threatened biological integrity in this portion of the Green River; Discharge points from numerous storm drains enter the river a short distance upstream from the sampling station; however, it is anticipated that the town of Greenfield's recent installation of new stormwater technology--the StormTreat System--may reduce the effects of stormwater runoff. In addition, coal tar globules have historically been observed in the storm drain lines and in one of the storm drain outfalls at Mead Street in the vicinity of the Berkshire Gas Company--site of a decommisioned coal-gasification plant. Dense coal tar globules were also observed in the Green River sediments, primarily in the impounded portion of the river adjacent to the Berkshire Gas Company property. Other potential nonpoint source pollution inputs are the numerous road, highway, and railroad crossings in the vicinity of downtown Greenfield.

HABITAT

Sampling was conducted immediately downstream from an unnamed footbridge off Route 5/10, approximately midway between the Meridian Street bridge and the confluence with the Deerfield River. The sampling reach was approximately 5 m wide and 0.25-0.5 m deep. Unlike the dammed portions of the Green River immediately upstream, adequate current velocity and an abundance of hard substrates (cobble and gravel) provided macroinvertebrates with excellent habitat throughout the sampling reach. Fish habitat was considerably less optimal, however, as limited pool areas were shallow and lacked stable cover. Some areas of erosion were observed along the steep portions of both banks, although instream deposition and embeddedness was minimal. Potential nearby sources of nonpoint source pollution were the residences along the left bank, and the playing fields and parking lot adjacent to the right bank; however, an abundance of sugar maples and vines (bittersweet) provided a good vegetative buffer along both banks. Dense algal growth (filamentous, blue-green) was observed on much of the instream substrate throughout the reach, indicative of organic enrichment in the water column.

GR01 received a total habitat assessment of 98, representing an 80% comparability to the regional reference station. Based on this evaluation (assessment category= "supporting"), GR01 was expected to support a relatively high quality benthic community.

BENTHOS

Following RBP II analysis, GR01 received a total metric score of 18, representing only a 43% comparability to the reference site (Table A3). Although this was the lowest benthos evaluation received in the survey, the moderate impairment score warranted additional analysis. RBP III analysis and recalculation of metrics again found the GR01 aquatic community to be moderately impaired. A total metric score of 14 was 33% comparable to the BR01 site (Table A4)--the lowest percent comparability to reference conditions in the survey.

The "supporting" habitat evaluation infers that water quality factors are resposible for the low impairment score for biological integrity at GR01. A worse than expected community composition--most notably the low species richness (score=2) and the loss of pollution sensitive EPT taxa (score=0)--is particularly indicative of water quality degradation. The numerical dominance of the filterer *Hydropsyche morosa* gr., and the scrapers *Optioservus* sp. and *Psephenus* sp., indicates an abundance of both suspended Fine Particulate Organic Material (FPOM) and algal food recources--both of which (especially FPOM) may suggest organic enrichment effects. The biotic index, developed as a means of detecting organic pollution, also scored poorly (score=2). It should be noted, however, that the strong representation by *Psephenus* sp., *Optioservus* sp. (a "riffle beetle"), and *Hydropsyche* sp. would not occur if dissolved oxygen levels were excessively low, as is often the case in areas with high algal densities and organic enrichment.

1988

GR01 was sampled in 1988 in the same location as during the 1995 survey. When using the regional reference station CR01, GR01 received a total metric score of 22, representing a 52% comparability to reference conditions (Table B2). The impairment designation, which was intermediate to the ranges for moderately impaired and slightly impaired, improved to slightly impaired when using an upstream control (GR02) as a reference site--a total metric score of 24 represented a 57% comparability to the “least impacted” reference on the Green River upstream from Greenfield (Table B3).

As with the 1995 survey, community composition was worse than expected at GR01. A reduction of EPT taxa and other intolerant forms, coupled with an increase in percent contribution of tolerant and dominant taxa, indicates water quality degradation. The high biotic index (6.83) and high percent contribution of dominant taxa (30%) are due to the numerical dominance of the chironomid *Cricotopus bicinctus*. The Chironomidae tend to become increasingly dominant in terms of relative abundance along a gradient of increasing enrichment or toxicity (Plafkin et al. 1989). The high density of *Cricotopus bicinctus* may indicate toxicant stress, as this species has been known to become numerically dominant in habitats exposed to metal discharges where EPT taxa are not abundant (Winner et al. 1980). The Hydropsychidae taxa, while abundant, are not dominant taxa as they are in the 1995 assemblage. According to Cummins (1987), filtering collectors--such as *Hydropsyche morosa gr*.--are sensitive to toxicants bound to fine particles and may decrease in abundance when exposed to sources of such bound toxicants. Cursory studies (IEP Incorporated 1990) of contamination effects on benthic macroinvertebrates in the Green River in the vicinity of Berkshire Gas Company suggested that toxic discharges might have originated from a storm drain outfall near the Berkshire facility at Mead Street.

It appears, then, that water quality in the vicinity of GR01 has continued to degrade since the 1988 survey. While it is difficult to target specific nonpoint source stressors, storm drains located upstream in the vicinity of Berkshire Gas Company and elsewhere are potential sources of inorganic/organic loadings associated with urban runoff. The impounding of the river--between Mill Street and Meridian Street--adjacent to several storm drains futher increases the potential for enrichment upstream of the sampling station. When these lentic systems are subjected to increasingly eutrophic conditions and/or excessive organic inputs--either from precipitation or land-based anthropogenic inputs--the resulting effects of enrichment (i.e. increased algal, plant, and DOM production) can be seen not only in the lentic fauna, but also the aquatic communities immediately downstream (Wiederholm 1984). The rich filter-feeding and grazing invertebrate assemblage at GR01 appears to reflect the effects of only mild enrichment (Wiederholm 1984), as those Hydropsychidae taxa--and for that matter, Elmidae (*Optioservus sp.*) and Psephenidae (*Psephenus* sp.)--would not be found in an oxygen-depleted zone of gross organic or inorganic pollution typically dominated by Chironomidae and Oligochaeta. The lack of substantial detrital accumulation, as determined by the habitat assessment, also corroborates the preclusion of excessive eutrophication and/or organic pollution in the sampling reach. Toxic pollutants--a perceived problem during the 1988 survey--no longer appear to contribute to water quality impairment at GR01, as reflected in the lack of indicator species (e.g. *Cricotopus bicinctus*) and abundance of filter-feeders (e.g. *Hydropsychidae* spp.) found there during the 1995 biosurvey. It is advised that biomonitoring be conducted at GR01 during future basin surveys, especially with the town of Greenfield’s recent implementation of the StormTreat system, which treats the first flush at the end of the storm pipe.

UDR01--Deerfield River (upper), Florida, MA (26 September 1995)

UDR01 was the more upstream of the two sampling stations in the mainstem Deerfield River. Biomonitoring was conducted here, and furthur downstream at LDR01 to investigate the two primary threats to biological integrity in the Deerfield River:

Wastewater Treatment

The Charlemont WWTP and the Shelburne Falls WWTP are the two largest wastewater treatment facilities on the Deerfield River. The Charlemont WWTP (NPDES# MA0103101), which provides treatment for portions of the town of Charlemont, exceeded NPDES permit conditions for BOD approximately one month before biomonitoring was conducted. In addition, the clogging of the sand filter beds (due to inadequate grain size) has been a persistent maintenence problem. The Shelburne Falls WWTP (NPDES# MA0101044), a larger facility, lies approximately 2.4 mi downstream from Charlemont and receives wastewater from the town of Shelburne Falls and the town of Buckland. The lower Deerfield River biomonitoring station (LDR01) lies approximately 7 miles downstream of the Shelburne Falls WWTP.

Although UDR01 served as an upstream reference site for LDR01, it too was downstream of a point source discharge. The Monroe WWTP (NPDES# MA0100188), a relatively small facility, is approximately 8-10 river miles upstream from the UDR01 biomonitoring station. The plant receives 100% domestic waste from 30 homes in the town of Monroe. Treatment consists of one Rotational Biological Contactor (RBC) with tertiary treatment, which replaced an extended aeration system in January 1995.

Flow Regulation

The primary perceived problem in the Deerfield River Basin is related to flow alterations controlled by power companies along the entire length of the river. Flow changes are regulated by the Federal Energy Regulatory Commission (FERC), which has recently relicensed the New England Power Company's (NEP) Deerfield River Hydroelectric Project (eight developments; 15 generating units) and Western Massachusetts Electric Company's (WMEC) Gardners Falls Hydroelectric Project (one development). Because of major changes to the flow regimes in the river resulting from the power company's authority to impound and release water for power generation, establishing a new water quality baseline is imperative.

Flow regime and current velocity are important hydrologic determinants of benthic community structure. Flow volume and velocity/depth combinations can have effects on substrate composition and stability, the amount of channel under water, and food availability (Minshall 1984). Current plays a crucial role in the distribution of benthic macroinvertebrates--current velocity affects an insect's ability to gather food, meet respiratory requirements, avoid competition and predation, and colonize or vacate certain habitats (Minshall 1984). Short-term flow fluctuations may modify aquatic insect communities in several ways, most notably by stranding aquatic insect in pockets of standing water or on exposed substrates. Mayflies are particularly susceptible to stranding and are relatively intolerant of exposure (Ward 1984). Increasing and decreasing discharge may induce drift of aquatic insects; that is, the downstream transport by current of benthic animals as a means of escape or dispersal (Wiley and Kohler 1984; Ward 1984). Populations of certain lotic forms may thus be depleted in streams below dammed impoundments because drift from upstream lotic reaches is unable to replenish the individuals lost from the regulated or fluctuating flow segment.

In addition to altered flow effects to the downstream lotic environment, the impoundment of a previously free-flowing river by damming--and subsequent hypolimnetic releases--may affect downstream temperature regimes. An unfortunate consequence of these altered temperature regimes may be the elimination of many species of aquatic insects (Ward 1984). On the other hand, the altered trophic structure below impounded segements--due to food sources of a lentic origin (e.g. phytoplankton)--may result in dense populations of taxa usually not found in unimpounded and oligotrophic lotic systems. Thus, the impoundments and releases created by stream regulation may affect downstream aquatic community composition and structure in a variety of ways.

HABITAT

With a width of approximately 15-20 m and a depth of 0.5-1 m, UDR01 was located approximately 300 m upstream from the Florida Bridge (Zoar Road) near the Florida-Savoy-Charlemont town lines. The majority of the land in this portion of the basin consists of undeveloped forest, with the village of Monroe Bridge being the only area of concentrated residential land use between Charlemont and the Vermont border. Potential sources of NPS pollution were the railroad and Zoar Road, which run very close to each side of the river in this portion of the watershed. Bottom substrates were considered excellent for macroinvertebrates, consisting of mostly boulder and cobble with virtually no embeddedness. Much of these substrates were covered with slimy and/or filamentous algae. As sampling was conducted before the scheduled flow releases from the Fife Brook Dam and Deerfield #5 Dam, deep riffle/pool areas were limited, providing fish with less than optimal habitat and macroinvertebrates with low habitat diversity. Both stream banks appeared stable and well vegetated--providing a good buffer from the nearby road and railroad.

BENTHOS

The UDR01 biomonitoring station served as an upstream reference for LDR01; however, anthropogenic impacts upstream (i.e. Monroe WWTP, NEP stream regulation) may preclude the validity of this designation. Nevertheless, the absence of comparable "reference quality" sites elsewhere in the basin, in terms of habitat and discharge, led to the selection of UDR01 as the reference. It was, unfortunately, impossible to establish the UDR01 biomonitoring station upstream of the Monroe WWTP, as the river here is impounded (NEP's Sherman Development). Because UDR01 is a "least impacted" site and is not compared to an additional reference station, it does not receive an impairment score for biological condition; however, the macroinvertebrate assemblage found there will be briefly discussed in qualitative terms.

Biological metric values for the UDR01 benthos are included in Table A3. Most striking is the low scraper/filterer ratio, which is unexpectedly low. While most large (fourth or fifth order) and open-canopied rivers are dominated by a scraper based assemblage (i.e. a periphyton-based trophic structure), filterers are the predominant feeding group at UDR01 (Table A1). In fact, almost 70% of the organisms identified are filtering collectors, with the Oligoneuriidae mayflies and Hydropsychidae caddisflies the most numerically dominant. According to Plafkin et al. (1989), the predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. In this case, the overabundance of FPOM--an important food item for filterers such as Hydropsychidae and Oligoneuriidae--is likely a result of organic enrichment or eutrophication. In addition to increasing phytoplankton production for filtering collectors, this enrichment is probably responsible for the dense filamentous algae cover on substrates at UDR01. In lieu of other sources of inorganic/organic loading to this portion of the basin, the Monroe WWTP seems a likely origin. Compounding the effects of enrichment are the NEP impoundments between Sherman Reservoir and the sampling station. Here phytoplankton becomes a primary source of autochthonous organic matter before being transported downstream as an available food resource for primary consumers (Merritt et al. 1984).

The abundance of Ephemeroptera (62 individuals) at UDR01 indicates that stranding effects caused by hydrologic control in this portion of the river are probably not a factor, at least in the sampling reach. Indeed, very few instream substrates were exposed during the time of sampling--which occurred prior to a scheduled dam release during a "very dry" summer. Likewise, those lotic taxa most dependent on current for respiration and food aquisition--most notably the EPT taxa--are numerous, suggesting that discharge-induced drift (caused by sudden dam releases) has not resulted in the depletion of rheophilic taxa in this portion of the river. In fact, both taxa richness and EPT index at UDR01 were higher than the 1988 survey's DE06 reference, which was used as a reference for the Deerfield River sampling stations during that survey.

1988

UDR01 was sampled during the 1988 biomonitoring survey as well. Again the station served as an upstream reference for sampling stations furthur downstream (LDR02, LDR01). In addition, UDR01 was compared to the regional reference station CR01.

UDR01 received a total metric score of 34, which represents an 81% comparability to CR01 and places biological status intermediate to the ranges for slight impairment and non-impairment (Table B2). Like the community sampled in 1995, overall richness was somewhat lower than expected (taxa richness=22), although EPT taxa were diverse (EPT index=11). Again, an assemblage dominated by filtering collectors (61%), and a high biotic index (5.45) suggests significant sources of FPOM and associated organic enrichment upstream. Enrichment effects were also seen in the dense algal cover on much of the instream substrate. It should be mentioned that low flow during sampling resulted in considerable substrate exposure, especially throughout the center of the channel. In addition, water temperatures here were high (24^{o}C) relative to most sampling stations in the basin.

LDR01--Deerfield River (lower), Deerfield, MA (28 September 1995)

HABITAT

LDR01 was located approximately midway between the Stillwater Bridge and Interstate 91, in a relatively undeveloped portion of the Deerfield River. Like the upper Deerfield River station, canopy cover throughout the sampling reach was open, with a forested riparian zone (sugar maple, red maple, butternut, sycamore) on both sides of the channel. Depth (0.5-1 m) and width (15-20 m) in this portion of the river were also similar to the upstream station. Grasses and shrubs (false bamboo, dogwood) occupied the margins of the left bank as well. Nonpoint source inputs were absent, with the exception of potential runoff from the bridges above and below the sampling reach. An abundance of cobble and boulder substrates, subjected to a variety of velocity/depth combinations provided excellent epifaunal habitat for macroinvertebrates. Deep riffles and pools with large boulders offered stable cover and good habitat for fish. Bank stability was excellent, and the forested riparian zone provided a good vegetative buffer from the nearby road (Stillwater Road).

LDR01 received a habitat assessment score of 126, which was actually higher than that received by the upstream reference site. In fact, habitat at LDR01 rated higher than any other biomonitoring station in the 1995 survey of this watershed.

BENTHOS

LDR01 received a total metric score of 30, representing a 77% comparability to the upstream reference station UDR01 and placing the aquatic community in the non-impaired category (Table A3). Most metric values (taxa richness, EPT index, scrapers/filterers, percent contribution of dominant taxa) were actually better than those of the reference conditions. A notable exception was the EPT/Chironomidae metric, whose value was “skewed” by the numerical dominance of filter-feeding EPT taxa (probably resulting from FPOM abundance) and much higher at UDR01 (98). In fact, lower densities of filterers at LDR01--and a subsequently higher scraper/filterer metric value (1.59)--suggests a more periphyton-based community composition, which is less indicative of upstream enrichment than the assemblage at UDR01. The higher richness and EPT index values at LDR01, also suggest that water quality may be less limiting to biological integrity here than at the upstream reference station.

It appears from the RBP analysis that the effects of point source discharges or stream regulation (NEP Developments 1-3 are in the vicinity of Shelburne Falls) are not seen in the relatively diverse and EPT taxa-rich benthic community in this portion of the river. However, a conservative approach should be taken when attempting to interpret the resulting benthos evaluation at LDR01, as known anthropogenic impacts to the UDR01 sampling station make it a somewhat unreliable reference site. Unfortunately, time restraints made locating and sampling a suitable regional reference station for this site impossible, and using the shredder-based closed canopy Bear River station (BR01) as a reference site is inadvisable due to differences in trophic structure and drainage area. It may be worth mentioning, however, that both taxa richness and the EPT index at LDR01 were higher than the 1988 survey’s DE06 station, which was used as a regional reference for the Deerfield River sampling stations during that survey.

It is imperative that use of an appropriate reference station (e.g., Cold River; Green River-upstream of Greenfield) be used in future biosurveys conducted on the mainstem Deerfield River, as water quality impacts related to point source discharges and stream regulation will continue to be important issues in this waterbody.

1988

As in the 1995 survey, comparisons to the upstream reference station found the macroinvertebrate community at LDR01 to be non-impaired. A total metric score of 36 represented an 86% comparability to the “best attainable” conditions upstream (Table B3). Biological integrity at LDR01 decreased slightly when compared to the regional reference station; A total metric score of 32, representing a 76% comparability to CR01 placed the LDR01 macroinvertebrate community in the slightly impaired category (Table B2). That biological impairment is detected in the LDR01 aquatic community when using the Cold

River site (CR01) as a reference, but not when using the upstream control (UDR01) as a reference, suggests that UDR01 may not be a reliable reference station for downstream study sites in the Deerfield River--corroborating those results of upstream-downstream comparisons made in 1995.

SUMMARY/RECOMMENDATIONS

BR01 (Bear River)--As a designated regional reference station, it is not surprising that habitat and biological integrity were considered excellent at BR01. The diverse macroinvertebrate assemblage, dominated by intolerant taxa, contained species (*Isogenoides* sp., *Lopescladius* sp.) previously unobserved in past biomonitoring surveys conducted by MADEP. While BR01 served as an adequate reference station for NOR01, SOR01, and GR01, it was inappropriate as a reference for those stations in the Deerfield River--a considerably larger drainage area offering a much different habitat than BR01.

NOR01 (North River)--Habitat here was highly comparable to reference conditions, although nonpoint source inputs in the form of sand deposition have impacted habitat quality downstream of the sampling reach. Implementation of better road runoff control is recommended, as sand appears to be entering the river from the road. Water quality effects from Veratec Inc. were not observed in the macroinvertebrate community found here, which was diverse and pollution sensitive. Water color changes, observed during routine water quality surveys, may have detrimental effects on fish ecology in this portion of the river.

Biological integrity at NOR01 seems to have improved since the 1988 biosurvey, when slight impairment to the aquatic communtiy was detected relative to the regional reference station.

SOR01 (South River)--It was difficult to discern the primary source of moderate impairment to the aquatic community at SOR01--habitat degradation in the form of sediment deposition in the sampling reach, or water quality factors upstream. An investigation into possible sources of sediment input is advised, as is macroinvertebrate sampling during future basin surveys--especially with the recent installation of an alternative technology wastewater treatment facility upstream.

Biological condition in the lower South River has degraded slightly since the 1988 survey. However, macroinvertebrate sampling in the 1988 survey was conducted upstream of possible sources of habitat degradation to the 1995 sampling station, which was located further downstream and below a small dam structure and some minor agricultural activity.

GR01 (Green River)--Moderate impairment to the aquatic community at GR01, as reflected in the low diversity and lack of EPT taxa in the macroinvertebrate assemblage sampled there, was due to water quality factors associated with its urban setting. Storm drains immediately upstream of the sampling station have historically been a source of organic/inorganic inputs to the river. Enrichment effects may be compounded by the presence of impoundments upstream, where a rich supply of FPOM has led to a predominantly filter-feeding macoinvertebrate community at GR01.

While biological condition rated better in 1988 than 1995, the numerically dominant toxic indicator *Cricotopus bicinctus* was not present in the 1995 sample. Biomonitoring should be conducted here in the future, especially with the recent implementation of new stormwater technology by the town of Greenfield.

UDR01 (Deerfield River)--UDR01 served as the upstream reference station for LDR01. While a qualitative benthos assessment found the macroinvertebrate assemblage to be fairly diverse and intolerant, an abundance of filterers suggested substantial sources of FPOM (and associated enrichment) upstream. Anthropogenic impacts upstream suggest that UDR01 may not be a reliable control for study sites downstream. Comparison to an appropriate regional reference site during future surveys is recommended.

Comparisons to a regional reference station during the 1988 survey found the upper Deerfield River aquatic community to be intermediate to the slight/non-impairment categories for biological impairment.

LDR01 (Deerfield River)--The LDR01 macroinvertebrate community, a more diverse assemblage (in terms of richness and EPT index) than that collected at the upstream control site, rated non-impaired for biological integrity. According to upstream-downstream comparisons, then, the primary perceived anthropogenic impacts to the Deerfield River--wastewater discharges and stream regulation--have not affected biological potential in this portion of the river. Likewise, results of the 1988 biosurvey found the macroinvertebrate community in this portion of the river to be non-impaired when compared to the upstream control site; slight/non-impairment was detected when compared to the regional reference station.

To better assess the effects of stream regulation and point source inputs to the Deerfield River, it is recommended that an appropriate regional reference site--either in the Cold River or the Green River (upstream from Greenfield)--be utilized for future biosurveys.

LITERATURE CITED

Barbour, M. T., J. B. Stribling, and J. R. Carr. 1995. The multimetric approach for establishing biocriteria and measuring biological condition. pp. 63-80. *in* W. S. Davis and T. P. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

IEP Inc. 1990. Biomonitoring Study of the Green River: Phase II Report. 13 pp.

Lamberti, G. A. and J. W. Moore. 1984. Aquatic insects as primary consumers. pp. 164-195. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Merritt, R. W. and K. W. Cummins (eds.). 1984. An Introduction to the Aquatic Insects of North America. Second edition. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Merritt, R. W., K. W. Cummins, and T. M. Burton. The role of aquatic insects in the processing and cycling of nutrients. pp. 134-163. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Minshall, G. W. 1984. Aquatic insect-substratum relationships. pp. 358-400. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89-001. Office of Water, US Environmental Protection Agency, Washington, DC.

Resh, V. H. 1988. Variability, accuracy, and taxonomic costs of rapid bioassessment approaches in benthic biomonitoring. Presented at the 36th annual North American Benthological Society meeting at Tuscaloosa, Alabama, 17-20 May 1988.

Ward, J. V. 1984. Ecological perspectives in the management of aquatic insect habitat. pp. 558-577. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Wetzel, R. G. 1975. Limnology. W. B. Saunders Co., Philadelphia, PA. 743 pp.

Wiederholm, T. 1984. Responses of aquatic insects to environmental pollution. pp. 508-557. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Wiley, M. and S. Kohler. 1984. Behavioral adaptations of aquatic insects. pp. 101-133. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Williams, D. D. 1984. The hyporheic zone as a habitat for aquatic insects and associated arthropods. pp. 430-455. *in* V. H. Resh and D. M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Publishers, New York, NY.

Winner, R. W., M. W. Boesel, and M. P. Farrell. 1980. Insect community structure as an index of heavy-metal pollution in otic ecosystems. Can. J. Fish. Aquat. Sci. 37: 647-655.

APPENDIX A

BENTHIC MACROINVERTEBRATE DATA FROM THE 1995
DEERFIELD RIVER WATERSHED SURVEY

Table A1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 26 and 28 September 1995. Sampling stations were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts.

TAXON	TV	FFG	UDR01	NOR01	SOR01	BR01	LDR01	GR01
Lumbricina	8	GC	2					
Hydracarina	6	PR			3			
Baetidae	4	GC	5	13		5	24	
Oligoneuriidae	2	FC	32	8	1	2	3	
Heptageniidae	4	SC	16	5	1	13	13	5
Ephemerellidae	1	GC	4	14	1	11	3	
Leptophlebiidae	2	GC	1			13		
Gomphidae	5	PR	1					
Perlidae	1	PR	2	1	1	8	1	
Perlodidae	2	PR				1		
Chloroperlidae	1	PR		1		3		
Corydalidae	5	PR		1		1		
Philopotamidae	3	FC	13	2		7	4	
Polycentropodidae	6	FC		1	1	1	2	
Hydropsychidae	4	FC	23	17	25	6	17	31
Rhyacophilidae	0	PR	1	1		2		
Glossosomatidae	0	SC		1	3	2	4	
Hydroptilidae	4	GC	1	1				
Brachycentridae	1	FC					1	
Lepidostomatidae	1	SH				2	1	
Limnephilidae	4	SH		1	1	1		
Odontoceridae	0	SH		1				
Psephenidae	4	SC		6	26	3	5	14
Elmidae	4	SC	1	25	21	6	14	33
Tipulidae	3	SH			2	1		2
Ceratopogonidae	6	PR			1	1		
Chironomidae	6	GC	1		2	7	6	4
Athericidae	2	PR		1		3		
Hydrobiidae	8	SC					1	
Ancylidae	7	SC			3		6	4
Pisidiidae	6	FC	1					
TOTAL			104	100	92	99	105	93

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR- Predator.
[2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table A2. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 26 and 28 September 1995. Sampling stations were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts

TAXON	TV	FFG	SOR01	BE01	GR01
Ferrisia fragilis	6	SC	1		4
Hydracarina	6	PR	3		
Baetidae	4	GC		5	
Isonychia sp.	2	FC	1	2	
Heptageniidae	4	SC		9	3
Rhithrogena sp.	0	SC		3	
Stenonema sp.	3	SC		1	2
Ephemerellidae	1	GC		11	
Ephemerella sp.	1	GC	1		
Leptophlebiidae	2	GC		10	
Paraleptophlebia sp.	1	GC		3	
Acroneuria sp.	0	PR		6	
Agtetina sp.	2	PR		1	
Neoperla sp.	3	PR		1	
Paragnetina sp.	1	PR	1		
Haploperla sp.	0	PR		3	
Isogenoides sp.	0	PR		1	
Nigronia sp.	0	PR		1	
Dolophiloides sp.	0	FC		7	
Polycentropodidae	6	FC		1	
Polycentropus sp.	4	PR	1		
Hydropsyche morosa gr.	6	FC	14	6	25
Cheumatopsyche sp.	5	FC	11		5
Macrostemum sp.	3	FC			1
Rhyocophila sp.	1	PR		2	
Glossosoma sp.	0	SC	3	2	
Lepidostoma sp.	1	SH		2	
Limnephilidae	4	SH	1	1	
Psephenus sp.	4	SC	27	3	14
Elmidae	4	GC	1		
Optioservus sp.	4	SC	20	5	28
Promoresia sp.	2	SC		1	
Stenelmis sp.	5	SC			3
Tipulidae	3	SH			1
Antocha sp.	3	GC	2	1	1
Probezzia sp.	6	PR		1	
Stilobezzia sp.	6	PR	1		
Conchapelopia sp.	6	PR		1	
Cricotopus tremulus gr.	7	SH			2
Cricotopus/Orthocladius sp.	7	SH			2

TAXON	TV	FFG	SOR01	BE01	GR01
Lopescladius sp.	4	GC		1	
Tvetenia bavarica gr.	5	GC	1	2	
Polypedilum aviceps	6	SH		2	
Stenochironomus sp.	5	GC		1	
Rheotanytarsus exiguus gr.	6	FC	1		
Atherix sp.	4	PR		3	
Hemerodromia sp.	6	PR	1		
TOTAL			92	102	91

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR- Predator.
[2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table A3. Summary of RBP II data analysis for macroinvertebrate communities sampled at six stream sites (BR01, NOR01, SOR01, GR01, UDR01, LDR01) in the Deerfield River Basin between 26 and 28 September 1995. Seven biological metrics were calculated and scored (in parentheses) for taxa collected at each station. Scores were totaled and compared to the regional reference site (BR01) or the upstream control site (UDR01). The percent comparability to the reference station yields a final impairment score for each study site.

STATION #	BR01[1]	NOR01	SOR01	GR01	UDR01[2]	LDR01
STREAM	Bear River	North River	South River	Green River	Deerfield River (upper)	Deerfield River (lower)
HABITAT SCORE	123	123	79	98	104	126
TAXA RICHNESS	22 (6)	18 (6)	15 (3)	7 (0)	15 (6)	16 (6)
BIOTIC INDEX	2.79 (6)	3.18 (6)	3.98 (3)	4.15 (3)	3.13 (6)	3.98 (3)
EPT INDEX	15 (6)	14 (6)	8 (0)	2 (0)	10 (6)	11 (6)
EPT/CHIRONOMIDAE	11 (6)	67/0 NA	17 (6)	9 (6)	98 (6)	12.17 (0)
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	1.71 (6)	1.32 (6)	1.03 (6)	1.81 (6)	.25 (6)	1.59 (6)
% CONTRIBUTION (DOMINANT FAMILY)	13% (6)	25% (6)	28% (6)	35% (3)	31% (3)	23% (6)
COMMUNITY SIMILARITY	100% (6)	48% (3)	28% (0)	26% (0)	100% (6)	46% (3)
TOTAL METRIC SCORE	42	33	24	18	39	30
% COMPARABILITY TO REFERENCE STATION		92%	57%	43%		77%
BIOLOGICAL CONDITION - DEGREE IMPAIRED	*REFERENCE*	NON-IMPAIRED	MODERATELY IMPAIRED	MODERATELY IMPAIRED	*REFERENCE*	NON-IMPAIRED
			RBPIII NEEDED	RBPIII NEEDED		

[1] Regional reference site for NOR01, SOR01, GR01
[2] Upstream reference site for LDR01

Table A4. Summary of RBP III data analysis for macroinvertebrate communities sampled at three stream sites (BR01, SOR01, GR01) in the Deerfield River Basin between 26 and 28 September 1995. Seven biological metrics were calculated and scored (in parentheses) for taxa collected at each station. Scores were totaled and compared to the regional reference site (BR01). The percent comparability to the reference station yields a final impairment score for each study site.

STATION #	BR01[1]		SOR01		GR01	
STREAM	Bear River		South River		Green River	
HABITAT SCORE	123		79		98	
TAXA RICHNESS	32	(6)	18	(2)	13	(2)
BIOTIC INDEX	2.39	(6)	4.30	(2)	4.74	(2)
EPT INDEX	20	(6)	9	(0)	5	(0)
EPT/CHIRONOMIDAE	11	(6)	17	(6)	9	(6)
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	1.50	(6)	1.86	(6)	1.74	(6)
% CONTRIBUTION (DOMINANT FAMILY)	11%	(6)	29%	(4)	31%	(2)
COMMUNITY SIMILARITY	100%	(6)	20%	(0)	19%	(0)
TOTAL METRIC SCORE		42		20		18
% COMPARABILITY TO REFERENCE STATION			48%		43%	
BIOLOGICAL CONDITION - DEGREE IMPAIRED	*REFERENCE*		MODERATELY IMPAIRED		MODERATELY IMPAIRED	

[1] Regional reference site for NOR01, SOR01, GR01

APPENDIX B

MACROINVERTEBRATE DATA FROM THE 1988 DEERFIELD RIVER WATERSHED SURVEY

Table B1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 18 and 20 July 1988. Sampling stations were in: Deerfield River (DE05, DE08, DE17), Cold River (DE06), North River (DE10, DE11), South River (DE15, DE16), Green River (DE18, DE19A).

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Amnicola limosa	SC	5	3									
Physidae	GC	8	3			1	1					
Ferrissia sp.	SC	6	4		1					3		3
Pisidiidae	FC	6	12									
Lumbriculus sp.	GC	8		1							4	
Baetidae	GC	6			5							1
Acentrella sp.	SC	4							1			
Baetis sp.	GC	6		1		2	6	8				
Isonychia sp.	FC	2	2			4				25	2	2
Heptageniidae	SC	3				1						
Stenonema sp.	SC	3			10					2	7	1
Ephemerellidae	GC	2										
Attenella attenuata	GC	1	1									
Drunella cornuta	GC	0		1		2		9				
Serratella sp.	GC	2		3	17	2	28					
Serratella serrata	GC	2							2	2		
Serratella serratoides	GC	2									1	
Tricorythodes sp.	GC	4					2				1	
Caenis sp.	GC	7									10	
Paraleptophlebia sp.	GC	1										
Potamanthus sp.	GC	4									1	
Ophiogomphus sp.	PR	1			1				1		5	
Pteronarcys sp.	SH	0		1	1		1				4	
Leuctra sp.	SH	0						1				
Perlidae	PR	3				2						
Acroneuria sp.	PR	0								1		
Perlesta placida	PR	5	1	11	14	1			3	5	4	9
Phasganophora capitata	PR	0		6	1		3		2			
Isoperla sp.	PR	2						1				
Chloroperlidae	PR	0						3				
Sialis sp.	PR	4									1	
Nigronia sp.	PR	0									2	
Chimarra sp.	FC	4	3									
Dolophilodes sp.	FC	0	1	1		9		2				
Nyctiophylax sp.	PR	5			1							
Phylocentropus sp.	FC	6		1								

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Cheumatopsyche sp.	FC	5	10	2		2	1			4		2
Hydropsyche betteni	FC	6	1									
Hydropsyche morosa gr.	FC	6	17	13	14	13	19	7	16	20	6	14
Macrostemum sp.	FC	3	1									
Rhyacophila sp.	PR	1	1					6				
Glossosoma sp.	SC	0			2		5		4	3		
Protoptila sp.	SC	1			1					1		
Agraylea sp.	GC	8										2
Brachycentrus sp.	FC	1					1			1		
Micrasema sp.	SH	2	2									
Psilotreta sp.	SC	0		1								
Oecetis sp.	PR	5			1							
Dineutus sp.	PR	4			5							
Psephenus herricki	SC	4							1		4	1
Optioservus sp.	SC	4						11	8	1		1
Promoresia sp.	SC	2	1									
Stenelmis sp.	SC	5				2	1		1	2		
Antocha sp.	GC	3										2
Dicranota sp.	PR	3						7				
Hexatoma sp.	PR	2		2		1		3	10		1	
Tipula sp.	SH	4						1				
Ceratopogonidae	PR	6		1	2				1			
Simulium fibrinflatum	FC	6								2		
Simulium venustum	FC	5						7				
Tanypodinae	PR	7		1					1		1	
Conchapelopia sp.	PR	6		8	2	2		1	1		7	3
Meropelopia sp.	PR	6										1
Thienemannimyia gr.	PR	6	2	1								1
Diamesa sp.	GC	5						2	1			
Pagastia sp.	GC	1	1	8				8	1			
Potthastia gaedii gr.	GC	2		1								
Potthastia longimanus	GC	2						2				
Cardiocladius albiplumus	PR	5							1			
Cricotopus sp.	GC	7					2					
Cricotopus/Orthocladius sp.	GC	7				1	1				3	4
Cricotopus bicinctus	GC	7	4	5		1	11	1			4	30
Cricotopus bicinctus gr.	GC	7				1						
Cricotopus tremulus gr.	SH	7		1								
Cricotopus trifascia gr.	SH	6										4
Cricotopus vierriensis	SH	7	8	1			1					1
Eukiefferiella claripennis gr.	GC	8						1				
Nanocladius sp.	GC	3										1
Orthocladius sp.	GC	6						1				

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Parametriocnemus sp.	GC	5						1	3			
Rheocricotopus sp.	GC	6										1
Synorthocladius sp.	GC	6					1					
Thienemanniella sp.	GC	6				1						
Tvetenia bavarica gr.	GC	5						10				
Tvetenia vitracies gr.	GC	5	6	2		1			7			1
Cryptochironomus sp.	PR	8							1			
Microtendipes sp.	FC	6									1	
Microtendipes pedellus	FC	6		3	6	6			4		2	
Microtendipes rydalensis gr.	FC	6				6					1	
Nilothauma sp.	GC	2									1	
Polypedilum sp.	SH	6					1					
Polypedilum aviceps	SH	6		5		8	1	4	1		1	
Polypedilum convictum	SH	6		6	7	12	3		22	1		
Cladotanytarsus sp.	FC	7			1							
Micropsectra sp.	GC	7				4			2			
Rheotanytarsus distinctissimus gr.	FC	6		1						2		
Rheotanytarsus exiguus gr.	FC	6	10	5	2	6	2				10	
Sublettea sp.	FC	4			2				1			1
Tanytarsus sp.	FC	6		2		3	1				4	1
Tanytarsus guerulus gr.	FC	6										1
Protoplasa fitchii	PR	5			1							
Atherix sp.	PR	4									2	
Chelifera sp.	PR	6						4				
Hemerodromia sp.	PR	6									1	9
TOTAL			94	96	97	97	94	100	97	93	91	99

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.
[2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table B2. Summary of RBP III data analysis for macroinvertebrate communities sampled at 10 stream sites in the Deerfield River watershed between 18 and 20 July 1988. Seven biological metrics were calculated and scored for taxa collected at each station. Scores were then totaled and compared to the regional reference station DE06. The percent comparability to the reference station yields a final impairment score for each station.

STATION #	DE06	DE05	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
STREAM	Cold River	Deerfield River	Deerfield River	North River	North River	South River	South River	Deerfield River	Green River	Green River
TAXA RICHNESS	28	22	22	25	21	23	25	18	26	24
BIOTIC INDEX	4.60	5.45	4.23	4.81	4.27	3.54	4.65	3.85	4.92	6.83
EPT INDEX	12	11	10	10	10	8	7	12	9	7
EPT/CHIRONOMIDAE	0.84	1.30	3.40	0.79	2.70	1.20	6.63	27	1.03	0.60
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	0.07	0.14	0.16	0.04	0.29	1.30	0.71	0.22	0.42	0.29
% CONTRIBUTION DOMINANT FAMILY	14%	18%	18%	13%	30%	11%	23%	27%	11%	30%
COMMUNITY SIMILARITY	100%	31%	44%	48%	36%	26%	37%	24%	37%	36%
TOTAL METRIC SCORE	42	34	34	36	30	34	28	32	34	22
% COMPARABILITY TO REFERENCE STATION		81%	81%	86%	71%	81%	67%	76%	81%	52%
BIOLOGICAL STATUS - DEGREE IMPAIRMENT	*Reference*	Slight-Non	Slight-Non	Non	Slight	Slight-Non	Slight	Slight	Slight-Non	Moderate-Slight

Table B3. Summary of RBP III data analysis for macroinvertebrate communities sampled at 9 stream sites in the Deerfield River watershed between 18 and 20 July 1988. Seven biological metrics were calculated and scored for taxa collected at each station. Scores were then totaled and compared to the upstream reference station. The percent comparability to the reference station yields a final impairment score for each station.

STATION #	DE05[1]	DE08	DE17	DE10[2]	DE11	DE15[3]	DE16	DE18[4]	DE19A
STREAM	Deerfield River	Deerfield River	Deerfield River	North River	North River	South River	South River	Green River	Green River
TAXA RICHNESS	22	22	18	25	21	23	25	26	24
BIOTIC INDEX	5.45	4.23	3.85	4.81	4.27	3.54	4.65	4.92	6.83
EPT INDEX	11	10	12	10	10	8	7	9	7
EPT/CHIRONOMIDAE	1.30	3.40	27	0.79	2.70	1.20	6.63	1.03	0.60
RIFFLE COMMUNITY: SCRAPER/FILTERERS	0.14	0.16	0.22	0.04	0.29	1.30	0.71	0.42	0.29
% CONTRIBUTION DOMINANT FAMILY	18%	18%	27%	13%	30%	11%	23%	11%	30%
COMMUNITY SIMILARITY	100%	18%	30%	100%	25%	100%	18%	100%	24%
TOTAL METRIC SCORE	42	36	36	38	32	42	28	42	24
% COMPARABILITY TO REFERENCE		86%	86%		84%		67%		57%
BIOLOGICAL STATUS-DEGREE IMPAIRED	*Reference*	Non	Non	*Reference*	Non	*Reference*	Slight	*Reference*	Slight

[1]Upstream reference for DE08, DE17
[2]Upstream reference for DE11
[3]Upstream reference for DE16
[4]Upstream reference for DE19A

APPENDIX D

Technical Memorandum

DEERFIELD RIVER WATERSHED - 2000 PERIPHYTON DATA

Prepared by Joan Beskenis
MA DEP/Division of Watershed Management, Worcester, MA
June 2003

During the summer of 2000, MA DEP personnel collected periphyton (attached algal community) samples from stations in the Deerfield River basin. Sampling was limited to sites chosen for macroinvertebrate investigations and was conducted as part of the macroinvertebrate/habitat assessment. It consisted of random scrapes of the substrate within the riffle zone for algal identifications and estimations of the percent cover of the algae within the reach. Occasionally other habitats, such as pools, were included for investigation. The aquatic communities (macroinvertebrates, periphyton and fish) are assessed, in part, to determine if the designated uses (Massachusetts Surface Water Quality Standards, 1996) are being supported, threatened or lost in particular segments. The Deerfield River segments included in this study are all Class B, but both Warm Water and Cold Water Fisheries are represented. Periphyton data can be used to evaluate two uses of the Deerfield River: Aquatic Life and Aesthetics.

Aquatic life evaluations are used to determine if suitable habitat is available for "sustaining a native, naturally diverse, community of aquatic flora and fauna." Natural diversity and the presence of native species may not be sustained when there are dense growths of a monoculture of a particular alga. This alteration of the community structure can mean that the aquatic life use support is lost or threatened. Important components of the food chain, which are vital for use support, may be lost from this alteration. In addition, the large amounts of biomass from macroalgae when they deteriorate and die can fill in the interstitial sites in the substrate and degrade this habitat for the benthic invertebrates, thus further compromising the aquatic life use support. Nuisance growths of algae can compromise the substrates and alter water chemistry (e.g., dissolved oxygen values).

Nuisance amounts of algae can be determined by gathering estimates of the percent cover as well as determining the relative amounts of both macroalgae (visible with naked eye) or microalgae (examined microscopically) in a particular habitat (e.g. riffles or pool) (Biggs, 1996, Barbour et al., 1999). The percent cover by filamentous green algae (macroalgae) greater than 40% is an indication that nuisance amounts of algae are present and that use of the benthic habitat by aquatic life may be threatened (Biggs 1996, Barbour et al., 1999).

The algal data are also used to determine if aesthetics have been impacted. Floating rafts of previously attached benthic mats can make an area visually unappealing, as can large areas of the bottom substrates covered with long streamers of algae.

The focus of this memo is to document if nuisance amounts of algal growth are present. This is based upon percent cover of the algal population as well as determination of the type and form of the algae that were present. Other objectives of the periphyton sampling were to learn more about the biota in the streams and rivers, to offer a means of comparing biological communities in conjunction with the macroinvertebrate and habitat information, and to examine community changes over time.

MATERIALS and METHODS

Periphyton Identifications and Relative Abundance

Periphyton data were gathered along with the macroinvertebrate and habitat data using methods described in Barbour et al. (1999). Sampling was done by John Fiorentino (MA DEP) and consisted of randomly scraping rocks and cobble substrates, typically within the riffle area, with a knife and collecting the material in a labeled glass vial. The samples were transported to the lab (MA DEP-DWM-Worcester) without refrigeration, but once at the lab they were refrigerated until identifications were completed.

The vial was shaken before subsampling to get a uniform sample. If filamentous algae comprised most of the sample they were removed first, identified separately and then the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications. Slides were typically examined under 200 power. Either a Palmer drop cell or a Sedgwick-Rafter cell were used in the examinations. If higher magnifications were needed then a water mount was prepared on a pre-cleaned glass slide. A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme for determining abundance is as follows:

R (rare)	fewer than one cell per field of view at 200x, on the average;
C (common)	at least one, but fewer than five cells per field of view;
VC (very common)	between 5 and 25 cells per field;
A (abundant)	more than 25 cells per field, but countable;
VA (very abundant)	number of cells per field too numerous to count.

This determination of abundance provides a relative approximation of the taxa that contribute the most to the biomass in the riffle or pool habitats. Information obtained from the algal identifications and relative abundance is combined with information obtained in the habitat assessment. Typically, a minimum of 10 fields are examined, but if only “rare” species are found then the entire slide will be scanned and after reshaking the sample, a second slide is prepared to make certain that clumping or some other non-uniform sampling error had not occurred.

RESULTS

Table 1 lists the locations, percent algal cover as well as the dominant algal type and final determination whether nuisance algal amounts were present. Periphyton taxa and relative abundance are presented in the appendix for each sampling station. No stations exhibited nuisance amounts of algae (i.e., no green macroalgae covered more than 40% of the bottom) using the system based on percent algal cover as outlined by Biggs (1996) and Barbour et al. (1999). In fact, filamentous or green macroalgal cover was less than 5%, and in some cases was less than 1%, at many sites supporting these forms of algae.

Table 1. Deerfield River Watershed Periphyton - 2000

Station Locations	Date	% Canopy Cover	% Algal Cover	Dominant Algal Type/ Forms - Habitat	Nuisance Algal Growth
Deerfield River (VI06ROA) near Mt Cutler, Williard, VT	26-Sep-2000	95	<1	Greens/filamentous - riffle	No
Cold River (CR01) at Mohawk Trail State Forest, upstream from Trout Brook, Charlemont	25-Sep-2000	0	60	Greens/filamentous -thin film riffle (thin coverage with some dense clumps)	No
Chickley River (CH01) approx. 900 m upstream from confluence with Deerfield River, Charlemont	25-Sep-2000	1	<1	Greens/diatoms/ filamentous -riffle-pool	No
Davis Mine Brook (DM00) upstream from Mill Brook, Charlemont	25-Sep-2000	50	<5	Greens/mat-riffle-pool	No
Taylor Brook (TB00) upstream from Heath Road, Colrain	26-Sep-2000	100	<5	Greens/thin film -riffle	No
North River (NOR01) upstream from Route 112 Shattuckville, Colrain	26-Sep-2000	<1	90	Blue-greens/ thin film - riffle	No
East Branch North River (NOR02A) downstream from Route 112, Colrain	26-Sep-2000	<1	100	Greens/ thin film/riffle-pool	No
Bear River (VP11BEA) approx. 100 m upstream from Shelburne Falls Road, Conway	27-Sep-2000	75	50	Greens/filamentous 1%, thin film 50%-riffle	No
South River (SOR01) upstream from Truce Road, Conway	27-Sep-2000	60	90	Diatoms/thin film -riffle	No
Deerfield River (LDR01) upstream from I-91 and downstream from Stillwater River Bridge, Deerfield	27-Sep-2000	0	90	Greens/ thin film -riffle	No
Green River (GR01) downstream from footbridge off of Route 5-10, Greenfield	27-Sep-2000	50	1	Blue-greens -riffle	No
Green River (GR02) downstream from Eugene Williams Drive, Greenfield	26-Sep-2000	0	ND	Blue-greens -riffle	No

ND-not determined or data missing

DISCUSSION

Based on the algal assemblage and the percent cover at each site the Aesthetics use does not appear to be threatened and the nonpoint sources contributing to the Deerfield River - such as those listed in the

Technical Memorandum - Deerfield River Watershed 2000 Biological Assessment (Fiorentino and Maietta, 2002) - do not appear to be severely impacting the algal community at this time.

The algal identifications (see appendix) offer limited information for the evaluation of Aquatic Life use support, especially since diatoms were not cleared and the number of samples was also limited. Some of the green filamentous algae found at stations in the Deerfield River basin such as *Mougeotia* sp., *Spirogyra* sp. and *Cladophora* sp., can grow to nuisance amounts, however, the biomass represented by these genera is currently small and would just provide habitat for invertebrate larvae or shelter for small organisms. The one station where examination of the changes in the algal community constituents and percent cover will be most informative is CR01 on the Cold River in Charlemont. Although this is a reference station for the macroinvertebrate analysis, and was not found to be impaired, some algal community alteration may be occurring in response to the nutrient provided by the local non-point sources including road runoff and the nearby campground (Fiorentino and Maietta, 2002). The algal cover at this location is described on the field sheets as a thin cover of green algae on rock surfaces with occasional dense clusters. The algal coverage was 60%. If the algal coverage in the riffle was entirely by the green filamentous alga (*Oedogonium* sp.) this station would likely be characterized as having nuisance aquatic growth which could be impairing the use of this reach. *Oedogonium* sp. is known for developing "higher-biomass" communities, particularly in low-velocity runs and pools (Biggs, 1996). At this time, however, this station's habitat scores highly (Fiorentino and Maietta, 2002) and it is only noteworthy because it "appeared" to be more productive than other areas.

The Deerfield River, at this time, does not appear to have nuisance amounts of algal biomass and the periphyton coverage would not restrict the stations evaluated from meeting the criteria for Aesthetic and Aquatic life uses.

REFERENCES CITED

Bahls, L. L. 1993. Periphyton Bioassessment Methods for Montana Streams. Water Quality Bureau, Department of Health and Environmental Sciences. Helena, Montana.

Barbour, M., Gerritsen, J, Snyder, B. D. and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, 2nd edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Biggs, B. J. F. 1996. *Patterns of benthic algae in streams*. In Algal Ecology: Freshwater Benthic Ecosystems. R. J. Stevenson, M. Bothwell, and R. L. Lowe. Pp 31-55. Academic Press, San Diego, California.

Fiorentino, J. and R. Maietta. 2002. Deerfield River Watershed 2000 Biological Assessment. TM-33-3-Technical Memorandum. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1996. Massachusetts Surface Water Quality Standards. Massachusetts Department of Environmental Protection. Division of Water Pollution Control, Technical Services Branch. Westborough, MA 114p. (Revision of 314 CMR 4.00, effective June 23, 1996).

Appendix

Deerfield River Watershed 2000 Periphyton Data

Date	Habitat	Class	Genus	Abundance
Location: Deerfield River near Mt Cutler, Willard, VT (Station VI06ROA)				
09/26/2000	rock/riffle	Chlorophyceae	*Rhizoclonium* (*heiroglyphyium*)	VA
Location: Cold River upstream from Trout Brook, Charlemont (Station CR01)				
09/26/2000	rock/riffle/margin	Chlorophyceae	*Bulbochaete* sp.	C
		Chlorophyceae	*Oedogonium* sp.	A
09/25/2000	rock/riffle/midstream	Chlorophyceae	*Mougeotia* sp.	VA
		Chlorophyceae	*Spirogyra* sp.	C
Location: Chickley River upstream from confluence with Deerfield River, Charlemont (Station CH01)				
09/25/2000	cobble/riffle	Bacillariophyceae	*Fragilaria* sp.	VA
		Bacillariophyceae	ui stalked pennate diatoms	VA
		Chlorophyceae	*Cladophora* sp.	R
		Chlorophyceae	green filament, *Hyalotheca*	VA
	cobble/pool	Chlorophyceae	*Cladophora* sp.	R
		Chlorophyceae	*Spirogyra* sp.	A
		Chlorophyceae	*Ulothrix* sp.	C
Location: Davis Mine Brook upstream from Mill Brook, Charlemont (Station DM00)				
09/25/2000	rocks/riffle	Chlorophyceae	*Ulothrix* sp.	R
Location: Taylor Brook upstream from Heath Road, Colrain (Station TB00)				
09/26/2000	rock/riffle	Bacillariophyceae	*Nitzchia* sp.	C
		Cyanophyceae	*Oscillatoria* sp.	R
Location: North River upstream from Route 112 Shattuckville, Colrain (Station NOR01)				
09/26/2000	rock/riffle	Cyanophyceae	*Oscillatoria* sp.	R
Location: East Branch North River downstream from Route 112, Colrain (Station NOR02A)				
09/26/2000	rock/riffle	Chlorophyceae	ui parenchymatous material	R
Location: Bear River approx. 100 m upstream from Shelburne Falls Road, Conway (Station VP11BEA)				
09/27/2000	rock/riffle	Bacillariophyceae	*Cocconeis* sp.	A
		Chlorophyceae	*Mougeotia* sp.	VA
Location: South River upstream from Truce Road, Conway (Station SOR01)				
09/27/2000	rock/riffle	Bacillariophyceae	ui pennate diatoms	A
		Chlorophyceae	ui parenchymatous green	C
		Cyanophyceae	*Calothrix* sp.	R
		Cyanophyceae	ui filamentous	C
Location: Deerfield River upstream from I-91 and downstream from Stillwater River Bridge, Deerfield (Station LDR01)				
09/27/2000	rock/riffle	Chlorophyceae	*Mougeotia* spp.	VA
Location: Greenfield River downstream from footbridge, off Rte 5-10, Greenfield (Station GR01)				
09/27/2000	rock/riffle	Bacillariophyceae	*Melosira* sp.	A
		Cyanophyceae	*Oscillatoria* sp.	VA
Location: Green River downstream from Eugene Williams Drive, Greenfield (Station GR02)				
09/26/2000	rock/riffle/run	Cyanophyceae	*Oscillatoria* sp.	VA
			fungal hyphae	A

APPENDIX E - MA DEP OWM/DWM FISH TOXICS MONITORING IN THE DEERFIELD RIVER WATERSHED 1995 AND 2000

INTRODUCTION

Fish toxics monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection Offices/Divisions- Watershed Management (MA DEP DWM), Research and Standards (ORS), and Environmental Analysis; the Massachusetts Department of Fish and Game (DFG) (formerly the Department of Fisheries, Wildlife, and Environmental Law Enforcement or DFWELE); and the Massachusetts Department of Public Health (MDPH). Fish toxics monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish, identify waterbodies where those concentrations may pose a risk to human health, and identify waters where toxic contaminants may impact fish and other wildlife.

Fish toxics monitoring in the Deerfield River Watershed was conducted by MA DEP DWM personnel between 1995 and 2000 in Sherman Reservoir (an impoundment of the Deerfield River) at the Monroe/Rowe, Massachusetts/Whitingham, Vermont State Line, Bog Pond in Savoy, and a reach of the Deerfield River in Greenfield.

PROJECT OBJECTIVES

Fish tissue monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, Polychlorinated biphenyls (PCB) and chlorinated pesticides. In 2000, MA DEP DWM Fish Toxics Monitoring was conducted under an EPA-approved Fish Contaminant Monitoring Quality Assurance Project Plan (MA DEP 2002). Data Quality Objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP.

METHODS

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing, and shipping fish collected for the fish toxics monitoring. Fish were collected from Sherman Reservoir on 11 October 1995 with boat mounted electroshocking gear, gill nets and trotlines (Figure E1). In 2000, fish were collected from Bog Pond on 8 November using gill netting and electroshocking gear. The Deerfield River (beginning one mile from the confluence with the Connecticut River and continuing upstream for approximately two miles) was sampled on 24 October 2000 using boat mounted electroshocking gear. Fish selected for analysis were placed in an ice filled cooler and brought back to the OWM/DWM laboratory for processing. Processing included measuring lengths and weights and visually inspecting fish for tumors, lesions, or other indications of stress or disease. Scales, spines, or pectoral fin ray samples were obtained from each sample to determine the approximate age of the fish. Fish were filleted (skin off) with stainless steel knives on glass cutting boards.

1995 fish toxics

Details related to the collection, handling, and processing of samples collected from Sherman Reservoir were excerpted from the report entitled *1995 Public Request Fish Toxics Monitoring Surveys* (Maietta 1995).

> Fillets targeted for metals analysis were placed in VWR high density polyethylene (HPDE) cups with covers. The opposite fillets were wrapped in aluminum foil for % lipids, PCB and organochlorine pesticide analysis. In the case of composite samples, two or three fillets from like-sized individuals of the same species were wrapped together in aluminum foil or stored in the single sample container. Samples were tagged and frozen for subsequent delivery to WES. All equipment used in the filleting and storage process was rinsed in accordance with USEPA procedures (1993). Methods used at WES for metals analysis include a cold vapor method using a VGA hydride generator for mercury and Varian 1475 flame atomic absorption for all remaining

metals. PCB/organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector.

2000 fish toxics

Details related to the collection, handling, and processing of samples collected from Bog Pond and the Deerfield River were excerpted from the report entitled *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000).

> All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR 32-ounce high density polyethylene (HDPE) cups with covers. Composite samples ranged from two to five fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the Department's Wall Experiment Station (WES).
>
> Methods used at WES for metals analysis include the following:
> Mercury is analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead are analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emission Spectrophotometer. Arsenic and selenium are analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer.
>
> PCB Arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Arochlors, Congeners, and Organochlorine Pesticides."

According to standard practice, all laboratory analytical results were forwarded to the Massachusetts Department of Public Health.

RESULTS

The results of MA DEP Deerfield River Watershed fish toxics monitoring surveys are described below for each sampling event (MA DEP 1995, MA DEP 2000, and Maietta and Colonna-Romano 2000). Data for these surveys are presented in tables E1 and E2 and sampling locations are depicted in Figure 1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MA DEP Division of Watershed Management office in Worcester (MA DEP 1995 and MA DEP 2000). Quality assurance data are available in the *Data Validation Report for Year 2000 Project Data* (MA DEP 2003).

Quality Assurance Quality Control and Data Validation for Fish Contaminant Monitoring Data

Due to the need to disseminate information quickly, DWM/WES generated/lab-validated fish contaminant data are typically used directly (upon receipt from the lab) by several groups (including DWM) without extensive external data validation. DWM does not (*ex post facto*) censor or qualify fish contaminant data once it has been used. Rather, specific comments are provided where poor field and/ or analytical accuracy/precision may have occurred. Additional discussion and QC sample data for fish contaminants from 1995-2000 can be found in the Data Validation Report for Year 2000 Project Data (MA DEP 2003).

1995 Fish Toxics

Sherman Reservoir F0001

Samples of brown bullhead, fallfish, longnose sucker, white sucker, and yellow perch were collected from Sherman Reservoir on 11 October 1995 (MA DEP 1995). Three, three-fillet composites of yellow perch, white sucker, and longnose sucker and an individual yellow perch and fallfish were analyzed at the Wall Experiment Station for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB arochlors and congeners, and pesticides. An individual brown bullhead sample was analyzed for percent lipid, PCB arochlors and congeners, and pesticide analysis.

Mercury in the fish tissue from Sherman Reservoir ranged from 0.204 to 0.785 mg/kg wet weight. The mercury data triggered a site-specific advisory against the consumption of fish from Sherman Reservoir (MDPH 1996).

1. *"Children younger than 12 years, pregnant women, and nursing mothers should not eat fish from this water body."*
2. *"The general public should not consume any yellow perch from this waterbody. The general public should limit consumption of non-affected fish species from Sherman Reservoir to two meals per month. "*

Selenium levels ranged from 0.138 to 0.327 mg/kg wet weight. PCB arochlors and congeners, pesticides, cadmium, arsenic, and lead were not detected in the edible fillets of all samples analyzed from Sherman Reservoir.

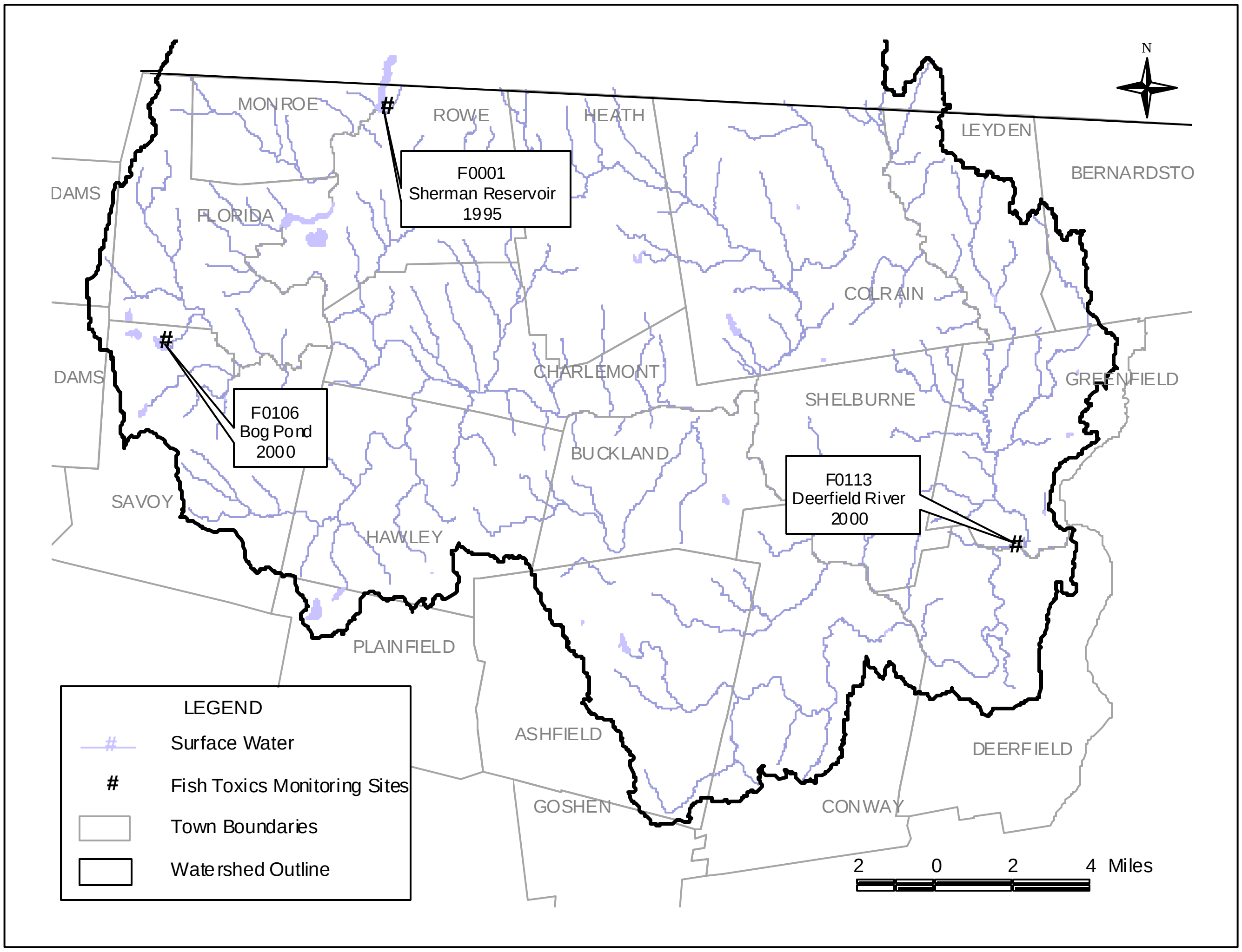

Figure E1. 1995 and 2000 MA DEP DWM fish toxics monitoring sites in the Deerfield River Watershed

2000 Fish Toxics

The results of MA DEP 2000 Deerfield River Watershed fish toxics monitoring surveys described below are excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000).

Bog Pond F0106

This 40-acre shallow pond is located within the Savoy State Forest in the Town of Savoy. The watershed is relatively undeveloped with one state campground and associated facilities located in the watershed.

Gill netting and electrofishing at Bog Pond resulted in the collection of three yellow perch (*Perca flavescens*) and three brown bullhead (*Ameiurus nebulosus*).

Mercury ranged from 0.14 mg/kg in the composite sample of brown bullhead (Bog00-04-06) to 0.38 mg/kg in the yellow perch composite sample (Bog00-01-03). Due to the fact that predator fishes tend to be highest in mercury worst case conditions have not been assessed. Predatory fish from Bog Pond may contain mercury in concentrations at or near the MDPH 'trigger level' of 0.5 mg/kg. Cadmium, lead, and arsenic were below MDLs (minimum detection limits) in all samples analyzed and selenium concentrations were consistent with those found in waterbodies throughout the Commonwealth. Selenium does not appear to be of concern.

PCBs and organochlorine pesticides were below method detection limits (MDLs) in two samples analyzed from Bog Pond.

Deerfield River F0113

The Deerfield River was sampled in its lower reaches starting at about one mile from the confluence with the Connecticut River and then continued upstream for approximately two miles.

Electroshocking the Deerfield River in Deerfield resulted in the collection of three white suckers.

Mercury in the white sucker composite sample (0.15mg/kg) was well below the MDPH "trigger level". Arsenic was detected at a concentration (0.048 mg/kg) just above the detection limit of 0.04 mg/kg. Cadmium and lead were below MDLs. The selenium concentration (0.232 mg/kg) was consistent with those concentrations found in other waterbodies within the Commonwealth and does not appear to be of concern.

PCBs and organochlorine pesticides were below method detection limits (MDLs) in the composite of white sucker analyzed from the Deerfield River.

REFERENCES

MA DEP. 1995. Open File. *1995 Fish Toxics Monitoring Data for the Deerfield River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2000. Open File. *2000 Fish Toxics Monitoring Data for the Deerfield River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2002. *Fish Contaminant Monitoring Program, Quality Assurance Project Plan, 2000.* CN 83.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2003. *Data Validation Report for Year 2000 Project Data*. CN083.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J. 1995. *1995 Public Request Fish Toxics Monitoring Surveys.* Massachusetts Department of Environmental Protection, Office of Watershed Management. Worcester, MA

Maietta, R. J. and J. Colonna-Romano. 2000. *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

MDPH. 1996. *Freshwater Fish Consumption Advisory List.* Massachusetts Department of Public Health. Boston, MA.

Table E1. 2000 DEP DWM Deerfield River Watershed fish toxics monitoring data excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000). Results, reported in wet weight, are from individual fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Bog Pond, Savoy, Deerfield River Watershed (F0106)													
BOG00-01	11/8/00	YP	23.9	180	2000069 (L2000454-1 metals) (L2000455-1 organics)	<0.020	<0.20	0.38	<0.040	0.196	0.17	ND[2]	ND
BOG00-02	11/8/00	YP	22.5	150									
BOG00-03	11/8/00	YP	24.1	180									
BOG00-04	11/8/00	BB	20.0	100	2000070 (L2000454-2 metals) (L2000455-2 organics)	<0.020	<0.20	0.14	<0.040	0.041	0.50	ND	ND
BOG00-05	11/8/00	BB	18.5	80									
BOG00-06	11/8/00	BB	18.7	80									
Deerfield River, Deerfield, Deerfield River Watershed (F0113)													
DRF00-01	10/24/00	WS	30.6	370	2000068 (L2000444-1)	<0.020	<0.20	0.15	0.048	0.232	0.70	ND	ND
DRF00-02	10/24/00	WS	29.8	300									
DRF00-03	10/24/00	WS	30.1	340									

[1] Species: brown bullhead (BB) *Ameiurus nebulosus,* white sucker (WS) *Castomus commersoni,* yellow perch (YP) *Perca flavescens*
[2] ND - not detected or the analytical result is at or below the established method detection limit (MDL) as follow:

PCB Arochlor and Pesticide Method Detection Limits (ug/g)

PCB A1242 – 0.26
PCB A1254 – 0.37
PCB A1260 – 0.11

PCB Arochlor and Pesticide Method Detection Limits (ug/g)

Chlordane – 0.11
Toxaphene – 0.59
a-BHC – 0.009
b-BHC- 0.011
Lindane – 0.009
d-BHC- 0.043
Hexachlorcyclopentadienne – 0.33
Trifluralin – 0.18
Hexachlorobenzene – 0.18
Heptachlor –0.012
Heptachlor Epoxide – 0.015
Methoxychlor – 0.029
DDD – 0.011
DDE – 0.010
DDT – 0.011
Aldrin – 0.016

PCB Toxic Congener Method Detection Limits (ug/g). Congeners are listed according to a numbering system developed by Ballshmiter and Zell (BZ#).
BZ#81 – 0.0005
BZ#77 – 0.0005
BZ#123 – 0.0011

PCB Toxic Congener Method Detection Limits (ug/g). Congeners are listed according to a numbering system developed by Ballshmiter and Zell (BZ#).

BZ#118 – 0.0025
BZ#114 – 0.0008
BZ#105 – 0.0019
BZ#126 – 0.0004
BZ#167- 0.0009
BZ#156 – 0.0007
BZ#157 – 0.0007
BZ#180 – 0.0007
BZ#169 – 0.0003
BZ#170 – 0.0007
BZ#189 – 0.0007

Table E2. Analytical results for 1995 Deerfield River Watershed Fish Toxics Monitoring Year 2 Watershed Surveys. Results, reported in wet weight, are from individual or composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (g)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids %	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Sherman Reservoir (Deerfield River Impoundment) (F0001)													
SRF95-1	10/11/95	WS	C	36.4	600								
SRF95-2	10/11/95	WS	C	38.7	700	<0.20	<1.00	0.204	<0.040	0.206	0.87	ND[3]	ND
SRF95-3	10/11/95	WS	C	36.1	550								
SRF95-4	10/11/95	LNS	C	34.0	530								
SRF95-5	10/11/95	LNS	C	33.7	470	<0.20	<1.00	0.785	<0.040	0.138	0.49	ND	ND
SRF95-6	10/11/95	LNS	C	33.5	500								
SRF95-7	10/11/95	YP	C	19.2	70								
SRF95-8	10/11/95	YP	C	17.8	70	<0.20	<1.00	0.606	<0.040	0.195	0.08	ND	ND
SRF95-9	10/11/95	YP	C	21.4	130								
SRF95-10	10/11/95	YP	I	32.0	470	<0.20	<1.00	2.45	<0.040	0.327	0.42	ND	ND
SRF95-11	10/11/95	FF	I	38.0	670	<0.20	<1.00	0.622	<0.040	0.161	0.48	ND	ND
SRF95-12	10/11/95	BB*	I	21.7	130						**	**	**

Notes: [1] Species
brown bullhead (BB) *Ameiurus nebulosus*
fallfish (FF) *Semotilus corporalis*
longnose sucker (LNS) *Rhinichthys cataractae*
white sucker (WS) *Castomus commersoni*
yellow perch (YP) *Perca flavescens*

[2] Sample Type (All samples were fillets with skin off.)
composite (C)
individual (I)
[3] ND = Not Detected
* Submitted for PCB and organochlorine pesticide analysis only.
** Sample lost during extraction process.

APPENDIX F
DWM LAKES SURVEY DATA
IN THE DEERFIELD RIVER WATERSHED 1995 AND 2000

1995

In the Deerfield River Watershed, DWM conducted synoptic surveys at 14 lakes during the 1995 field season. Observations, from at least one access point on each lake (multiple access points on larger lakes) were recorded on standardized field sheets. An attempt was made to observe the entire surface area of each lake to determine the extent of aerial macrophyte cover. At each sampling location general water quality conditions, identification and abundance of aquatic and wetland macrophyte plant species, and estimates of total percent aerial coverage were recorded (Table F1). Macrophyte visual observations were augmented at each station by identifying plant specimens collected from the lake bottom. Specimens were retrieved using a “rake” (a short handled, double-sided garden rake on a 50 foot line) thrown to its maximum extension in multiple directions at each station. Macrophytes collected in the “rake” were identified (in-situ or in the laboratory) and recorded on the field sheets. Transparency was measured where possible using a standard 20-centimeter diameter Secchi disk. Where Secchi disk measurements were not feasible, transparency was estimated as being above or below 1.2 meter (the MDPH bathing beach standard). Trophic status was estimated primarily using visual observations of macrophyte cover and phytoplankton populations. A more definitive assessment of trophic status would require more extensive collection of water quality and biological data.

Table F1. 1995 Deerfield River Watershed lake observations and trophic status estimates.

Lake, Town	Waterbody Identification Code (WBID)	Trophic Status Estimate	Survey Observations (Objectionable Conditions)
Ashfield Pond, Ashfield	MA33001	Mesotrophic	Good water clarity, some silt deposition on rocks, green algal bloom in cove, clean gravel shoreline, <25% abundance of *Potamogeton* sp. and *Elodea* sp., <10% emergent
Bear Swamp Pumped Storage, Rowe	MA33026	Undetermine d	Slightly brown stained water, no aquatic plants observed, 100% rock shoreline, water ~15 feet below high water mark
Bog Pond, Savoy	MA33003	Undetermine d	Slight brown stained water, >50% of pond covered by shrub islands, >75% of open water covered by floating plants, *Myriophyllum* sp. noted
Burnett Pond, Savoy	MA33005	Mesotrophic	Slight brown tint to water, some organic floc on bottom at dam, >50% of pond covered by plants
Goodnow Road Pond, Buckland	MA33007	Eutrophic	Slightly cloudy water, greenish algal blooms present, >50-75% aquatic plant cover
Hallockville Pond, Hawley/Plainfield	MA33009	Mesotrophic	Slightly turbid water, lots of decaying vegetation, >75% cover of floating leaf, submergent, and emergent plants
Lower Reservoir, Rowe/Florida	MA33028	Undetermine d	Very good clarity, dusty film on surface, no aquatic plants observed, low water level
McLeod Pond, Colrain	MA33012	Eutrophic	Slightly turbid water with brownish-green tint, 75-100% aquatic plant cover
North Pond, Florida	MA33014	Undetermine d	Very good clarity, sandy bottom, <10% aquatic plant density

Table F1 (continued). 1995 Deerfield River Watershed lake observations and trophic status estimates.

Lake	Waterbody Identification Code (WBID)	Trophic Status Estimate	SURVEY OBSERVATIONS (Objectionable Conditions)
Pelham Lake, Rowe	MA33016	Undetermined	Brownish/cloudy water, <25% aquatic plant cover, Secchi disk off dam 2.1 meters
Plainfield Pond, Plainfield	MA33017	Mesotrophic	Slightly turbid water, 25-50% aquatic plant cover
Sherman Reservoir, Rowe, MA / Monroe, MA / Whitingham, VT	MA33018	Mesotrophic	Slightly green/yellow stained water, algae mats on bottom (possibly blue-green algae), <10% aquatic plant cover
South Pond, Savoy	MA33019	Undetermined	Good water clarity, slightly brownish, some organics on pond bottom, <10% aquatic plant cover
Tannery Pond, Savoy	MA33020	Undetermined	Turbid, brownish water, 100% aquatic plant cover, <1 acre of standing water, old dam/ beaver dam washed out quite a while ago, small stream channel through bushy old pond outline

All waterbodies are class B
WBID – Waterbody Identification code.
Trophic State: E= Eutrophic, M= Mesotrophic, U= Undetermined.
Note: M. sp. – Possible *Myriophyllum heterophyllum* , requires further confirmation when flowering heads are evident.
Little Mohawk Road Pond, Shelburne (MA33027) and Schneck Brook Pond, Conway (MA33029) were surveyed but were found to be wetlands.

2000

In the Deerfield River Watershed, baseline lake surveys were conducted in July, August, and September 2000 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Two waterbodies, Pelham Lake and Plainfield Pond were sampled three times each (generally at monthly intervals). A technical memorandum by Dr. Mark Mattson entitled *Baseline Lakes 2000 Technical Memo* provides details of sample collection methods, results, data, and weed maps for the lakes surveyed in the Deerfield, Millers, Shawsheen, Ipswich, Islands, and Buzzards Bay watersheds in 2000 (MA DEP 2000).

In situ measurements using the Hydrolab® (measures dissolved oxygen, water temperature, pH, conductivity, and depth and calculates total dissolved solids and % oxygen saturation) were recorded. At deep hole stations measurements were recorded at various depths creating profiles. In-lake samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* (MA DEP 1999a and MA DEP 1999b). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedure (SOP). Both quality control samples (field blanks, trip blanks, and split samples) and raw water quality samples were transported on ice to WES on each sampling date; they were subsequently analyzed according to the WES SOP. Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is also presented in Appendix A. Apparent color and chlorophyll *a* were measured according to standard procedures at the MA DEP DWM office in Worcester (MA DEP 1999c and MA DEP 1999d). An aquatic macrophyte survey was conducted at each lake. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded. Details on procedures used can be found in the *Baseline Lake Survey Quality Assurance Project Plan* (MA DEP DWM 1999e). Data was excerpted from the *Baseline Lake Survey 2000 Technical Memo* and presented in tables F2 and F3.

Table F2. 2000 DEP DWM Deerfield River Watershed Baseline Lakes *in-situ* Hydrolab® data

Pelham Lake (Palis: 33016) Unique_ID[1]: 766 Station: A
Description: western lobe of lake, Rowe

Date	OWMID[2]	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	**(m)**	**(C)**	**(SU)**	**(uS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/19/2000									
	LB-1006	12:36	** m	**m	**m	**m	--	**m	--
		12:39	** m	**m	**m	**m	--	**m	--
		12:42	** m	**m	**m	**m	--	**m	--
		12:46	** m	**m	**m	**m	--	**m	--
		12:49	** m	**m	**m	**m	--	**m	--
8/15/2000									
	LB-1049	13:13	** m	**m	**m	**m	--	**m	--
		13:16	** m	**m	**m	**m	--	**m	--
		13:22	** m	**m	**m	**m	--	**m	--
		13:26	** m	**m	**m	**m	--	**m	--
		13:29	** m	**m	**m	**m	--	**m	--
		13:33	** m	**m	**m	**m	--	**m	--
9/14/2000									
	LB-1091	11:30	0.1	21.1	6.7	27.9	--	8.6	--
		11:33	0.5	21.0	6.7	27.9	--	8.6	--
		11:36	1.0	20.9	6.7	27.8	--	8.6	--
		11:40	1.5	20.9	6.7	27.9	--	8.6	--
		11:43	2.0	20.4	6.6	27.9	--	8.5	--
		11:47	2.5	20.4	6.6	28.0	--	8.5	--
		11:52	3.0	20.4	6.6	28.1	--	8.5	--

Plainfield Pond (Palis: 33017) Unique_ID: 765 Station: A
Description: northeast quadrant of pond, Plainfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	**(m)**	**(C)**	**(SU)**	**(uS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/19/2000									
	LB-1010	10:42	** m	**m	**m	**m	--	**m	--
		10:45	** m	**m	**m	**m	--	**m	--
	LB-1010	10:48	** m	**m	**m	**m	--	**m	--
		10:51	** m	**m	**m	**m	--	**m	--
8/15/2000									
	LB-1053	11:08	** m	**m	**m	**m	--	**m	--
		11:12	** m	**m	**m	**m	--	**m	--
		11:16	** m	**m	**m	**m	--	**m	--
		11:19	** m	**m	**m	**m	--	**m	--
		11:22	** m	**m	**m	**m	--	**m	--
		11:25	** m	**m	**m	**m	--	**m	--
9/14/2000									
	LB-1095	10:02	0.1	20.3	6.7	29.5	--	8.3	--
		10:06	0.5	20.3	6.7	29.4	--	8.3	--
		10:09	1.0	20.1	6.7	29.4	--	8.2	--
		10:13	1.5	20.0	6.7	29.5	--	8.3	--

[1]Unique ID = unique station identification number.
[2]OWMID = sample tracking number.
" ** " = Censored or missing data (i.e., data that should have been reported)
" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.
" -- " = No data (i.e., data not taken/not required)

Table F3. 2000 DEP DWM Deerfield River Watershed Baseline Lakes *physico-chemical* data.

Pelham Lake (Palis: 33016) Unique_ID[1]: 766 Station: A

Description: western lobe of lake, Rowe

Date	Secchi	Secchi Time	Station Depth	OWMID[2]	QAQC	Time	Sample Depth	Alkalinity	TP	Color	Chl a
	(m)	24hr	(m)			24hr	(m)	(mg/l)	(mg/l)	PCU	(mg/m3)
7/19/00	1.3	12:30	3.0								
				LB-1001	LB-1002	**	0.5	<2	0.043d	29d	--
				LB-1002	LB-1001	**	0.5	2	0.027d	17d	--
				LB-1003	BLANK	**	--	<2	<0.005	<15	--
				LB-1004		**	** - **[3] m	--	--	--	1.4 m
				LB-1005		**	**m	3m	0.082 m	29m	--
8/15/00	>3.0	13:09	3.0								
				LB-1043	LB-1044	**	0.5	4	0.013	35	--
				LB-1044	LB-1043	**	0.5	4	0.013	--	--
				LB-1045	DUP	**	0.5	4	0.018	29	--
				LB-1046	BLANK	**	--	<2	<0.005	<15	--
				LB-1047		**	2.5	5	0.015	35	--
				LB-1048		**	0 - 2.5	--	--	--	** m
9/14/00	2.9	11:26	3.0								
				LB-1085	LB-1086	**	0.5	5	0.012	38d	--
				LB-1086	LB-1085	**	0.5	6	0.010	<15d	--
				LB-1087	DUP	**	0.5	4	0.009	31	--
				LB-1088	BLANK	**	--	<2	<0.005	<15	--
				LB-1089		**	2.5	4	0.022	39	--
				LB-1090		**	0 - 2.5	--	--	--	1.6 h

Plainfield Pond (Palis: 33017) Unique_ID: 765 Station: A

Description: northeast quadrant of pond, Plainfield

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Alkalinity	TP	Color	Chl a
	(m)	24hr	(m)			24hr	(m)	(mg/l)	(mg/l)	PCU	(mg/m3)
7/19/2000	>2.2	10:36	2.2								
				LB-1007		**	0.5	4	0.009	<15	--
				LB-1008		**	**m	4m	0.037m	29m	--
				LB-1009		**	**m	--	--	--	1.0 m
8/15/2000	>2.6	11:05	2.6								
				LB-1050		**	0.5	5	0.010	21	--
				LB-1051		**	2.1	5	0.014	29	--
				LB-1052		**	0 - 2.1	--	--	--	3.9
9/14/2000	>2.5	10:00	2.5								
				LB-1092		**	0.5	3	0.007	<15	--
				LB-1093		**	2.0	5	0.009	24	--
				LB-1094		**	0 - 2.0	--	--	--	4.1 h

[1]Unique ID = unique station identification number.
[2]OWMID = sample tracking number.
[3]depth of integrated sample not recorded on field sheet.
" ** " = Censored or missing data (i.e., data that should have been reported)
" -- " = No data (i.e., data not taken/not required)
" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" h " = holding time violation (usually indicating possible bias low)
" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

References

MA DEP. 1995 January Draft. *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis. Wall Experiment Station, Lawrence, MA.

MA DEP. 1999a. CN 1.0 *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure*. October 25, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999b. CN 4.0 *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure*. September 23, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999c. CN 2.0 *Apparent Color Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999d. CN 3.0 *Chlorophyll a Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999e. *Baseline Lake Survey Quality Assurance Project Plan.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2000. CN 161.0. *Baseline Lake Survey 2000 Technical Memo.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

APPENDIX G
OWM/DWM WATER QUALITY MONITORING DATA
DEERFIELD RIVER WATERSHED 1995 THROUGH 1997

Based on a review of the water quality reports and in view of the water quantity regulation, it was determined that a year long monitoring study was needed for a better understanding of water quality and hydrology in the Deerfield River Basin and to establish a baseline of data for future trend analysis. The following general objectives were outlined for the 1995/1996 Deerfield River Basin survey:

- To define areas impacted by pollution,
- To determine if impacts are caused by point or nonpoint sources,
- To determine the need for permit reissuance or modification for WMA and NPDES permits, and
- To determine the need for Best Management Practices (BMPs) to minimize nonpoint source pollution.

Modifications were made to the monitoring plan over the course of the 1995/1996 sampling period as more was learned about specific problems in the watershed, as the team became more familiar with the watershed, and as local groups and agencies made suggestions. The following issues were addressed, at least partially, in the modified monitoring plan:

- Agricultural nonpoint runoff in the Chickley River, Clesson Brook, and South River basins,
- Stormwater runoff in Greenfield,
- Failing septic systems in Ashfield,
- Erosion problems on the North River,
- Acid mine drainage from the Davis Mine in Rowe,
- Industrial discharge toxicity and coloring agent affecting the North River, and
- Mercury contamination of fish in Sherman Reservoir.

The 1995/1996 Deerfield River Basin survey required the assistance and cooperation of various local groups and agencies (Deerfield Compact, Green River Watershed Preservation Alliance, Franklin County Conservation District), the US EPA and the Greenfield Wastewater Treatment Plant, which analyzed the bacteria samples. The water quality sampling matrix for the DWM 1995/1996 Deerfield River Basin survey is summarized in Table G1. Instream water quality sampling included the following:

- Pathogens-- Monthly sampling at seven permanent stations from June 1995 - June 1996. Less frequent sampling was conducted on most of the major tributaries during both wet and dry weather. Special surveys were conducted on the South River, Chickley River, Clesson Brook, Bear River, Mill Brook, and the Green River.
- pH-- Davis Mine Brook was sampled during July 1996 to investigate the impact of acid mine drainage.
- Nutrients and general water chemistry-- The seven permanent stations were sampled monthly and samples were collected from the major tributaries on one sampling date.

Conditions prior to each synoptic survey were characterized by analyzing precipitation and streamflow data. Two weather stations, DEM's Heath Station 201 and Plainfield2 Station 205, were used to determine precipitation and weather conditions prior to the sampling dates: data for these stations was provided by DEM Office of Water Resources. Discharge, (hereinafter refereed to as streamflow) and duration data were obtained from the continuous United States Geological Survey (USGS) stream gages. USGS maintains six flow monitoring stations in the Massachusetts portion of the basin; three on the mainstem Deerfield River: 01168151 Deerfield River downstream of Fife Brook Dam, Rowe, 01168500 Deerfield River downstream from confluence with the Chickley River, Charlemont and 01170000 Deerfield River downstream from confluence with the South River, West Deerfield. The other three are located on the North River (01169000) in Shattuckville, South River (01169900) near Reeds Bridge, Conway and Green River (01170100) near Colrain. The data from these gages was used to calculate streamflow characteristics for the period of record. These statistical analyses can be found in *Water Resources Data Massachusetts and Rhode Island, Water Year 1995* (Socolow *et al.* 1996). Stream discharge was measured at two additional stations by DEP DWM personnel according to standard operating procedures (MA DEP 1990) using a Swoffer meter (model 2100) or a Price Type AA meter with polymer buckets using a bridge board; one station (BE) on the Bear River in Conway and one station on the Green River (5-10) upstream of the Greenfield WWTP in Greenfield. Field data were recorded on standard flow gauging field sheets. Data reduction and stream discharge calculations were performed at the DWM office in Worcester.

Additionally, *in-situ* water quality monitoring was conducted by DWM in 11 streams in 1996/1997 in the Deerfield River Watershed as part of the 104b(3) Numeric Biocriteria Development Project surveys. Water quality sampling was restricted to *in-situ* Hydrolab® measurements of depth, pH, dissolved oxygen, conductivity, temperature, total dissolved solids, and turbidity.

MATERIALS AND METHODS

Procedures used for sampling technique and sample handling are outlined in the *BASINS PROGRAM Standard Operating Procedures River and Stream Monitoring* (MA DEP 1990). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied bottles and field preservatives for all sampling, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES standard operating procedures (SOP) with the exception of the fecal coliform and fecal streptococci samples. Quality control samples generally included field blanks and sample splits or field replicates. Water temperature, dissolved oxygen and pH measurements were made *in situ* at each station using a pre-calibrated Scout 2 Hydrolab multi-parameter meter. With the exception of the 20 July 1995 bacteria samples analyzed at WES, the fecal coliform and fecal streptococci samples were delivered to the Greenfield Wastewater Treatment Facility laboratory for analysis where all testing was done in accordance with Standard Methods 18th edition, Sec. 9222D and Sec. 9230.

QUALITY ASSURANCE AND QUALITY CONTROL

In general, monitoring surveys in the Deerfield River Watershed in 1995/1996 were performed with attention to maintaining quality assurance and control of field samples and field-generated data. Field monitoring activities followed accepted DWM standard operating procedures. Where strict procedures were not in place or necessary, it is assumed that DWM field staff exercised best professional judgment.

With the exception of fecal coliform sampling where no field blanks were taken, the majority of water quality surveys included quality control samples (field blanks and sample splits) at a minimum of one each per crew per survey during the entire 1995/1996 Deerfield River Watershed survey.

The water quality sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). Data not meeting general data quality objectives of DWM were censored (no data were qualified). Data validation for the 1995/1996 DWM water quality surveys is available in a Memorandum - *1994, 95 & 96 QA/QC Assessment Report* (MA DEP 2000). Specific decisions pertaining to the Deerfield River Watershed data were excerpted from this memorandum and appear in Table G2. Three bacteria samples (OWMID numbers 33-0038, 33-0039 and 33-0040) were also censored because the stations/times of collection couldn't be verified on the laboratory reports and laboratory errors were responsible for two additional bacteria samples (OWMID numbers 33-0129 and 33-0133) being censored. Insufficient sample volumes resulted in one TKN sample (OWMID 33-0117), three alkalinity samples (OWMID numbers 33-003, 33-004, and 33-005), and one chloride sample (OWMID 33-002) being censored. All Hydrolab® multi-probe data were validated using multi-staff review. Data symbols (e.g., ** for censored/missing data) were applied to Hydrolab® data as necessary (see Table G3).

RESULTS

Synoptic water quality surveys were conducted in the Deerfield River Watershed at the stations identified in Figure G1. Table G1 provides the sampling matrix summary for water quality surveys conducted in the Deerfield River Watershed between 1995 and 1997. *In-situ* Hydrolab® data from the 1995/1996 Deerfield River Watershed Monitoring surveys and the 1996/1997 104b(3) Numeric Biocriteria Development Project sites are presented in Table G3. Water quality data from the 1995/1996 Deerfield River Watershed Monitoring survey can be found in Table G4 and DWM generated flow data are in Table G5.

Table G1. Sampling Matrix for 1995/1996 DWM Deerfield River Watershed Water Quality Surveys.

STATION ID	UNIQUE ID	1995 JUNE	1995 JULY	1995 AUG.	1995 SEPT.	1995 OCT.	1995 NOV.	1995 DEC.	1996 FEB.	1996 MAR.	1996 APR.	1996 MAY	1996 JUNE	1996 JULY
UD01	W0004	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W				B,H,N,W	B,H,N,W	B,H,N,W	
UD02	W0003							B,H,N,W	B,H,N,W	B,H,N,W				
LD	W0002	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
5-10	W0001				B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W,	B,H,N,W	B,H,N,W,	B,H,N,W	B,H,N,W	
GR07	W0007			B,H										
GR08	W0006			B,H										
GR	W0005	B,H,N,W	B,H,N,W	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	
SO-1	W0015		B,H											
SO-2	W0016		B,H											
SO-3	W0014		B,H											
SO-4	W0013		B,H											
SO-5	W0012		B,H											
SO-6	W0011		H											
SO-7	W0010		B,H											
SO-8	W0009		B,H											
SO	W0008	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
BR03	W0019				B,H									
BR02	W0018				B,H									
BE	W0017		B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	
NR04	W0022			B,H										
NR03	W0021			B,H										
NO	W0020	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
NR01	W0023			B										
EBNR06	W0024			B,H										
WBNR05	W0025			B,H										
SH01	W0028				B,H									
CL02	W0027				B,H									
CL	W0026				B,H	B,H	B,H	B,H		B,H	B,H,N,W	B,H	B,H	
CK	W0029						B,H	B,H			B,H,N,W	B,H	B,H	
CL03	W0030				B,H									
UB01	W0031				B,H									
MB-A	W0363													H
MB-B	W0361													H
MIL2	W0032				B,H									
MI	W0033				B,H		B,H	B,H			B,H,N,W			
DMB-1	W0366													H

Table G1 continued. Sampling Matrix for 1995/1996 DWM Deerfield River Watershed Water Quality Surveys.

STATION ID	UNIQUE ID	1995 JUNE	1995 JULY	1995 AUG.	1995 SEPT.	1995 OCT.	1995 NOV.	1995 DEC.	1996 FEB.	1996 MAR.	1996 APR.	1996 MAY	1996 JUNE	1996 JULY
UKN	W0364													H
DMB-2	W0365													H
DMB-B	W0362													H
MIL3	W0034				B,H									
BO	W0035				B,H		B,H	B,H			B,H,N,W			
CH5	W0039				B,H									
CH4	W0038				B,H									
CH3	W0037				B,H									
CH7	W0036				B,H									
CH	W0040				B,H	B,H	B,H	B,H		B,H	B,H,N,W	B,H	B,H	
CH2	W0041				B,H									
CH6	W0042				B,H									
CO	W0043				B,H	B,H	B,H	B,H		B,H	B,H,N,W		B,H	
PE	W0044						B,H	B,H			B,H,N,W			

STATION ID	UNIQUE ID	September 1996	September 1997	October 1997
VP05HIN	W0274	H		H
VP05HIN	W0275	H		
VP02SHN	W0276	H		
W0277	W0277	H		
VP01DRG	W0278	H		
VP12BEA	W0279	H	H	
VP11BEA	W0280	H	H	
VP13DRK	W0281	H	H	
VP07FOU	W0282	H		H
VP08TIS	W0283	H		H
VP10CLE	W0284	H		
VP09CLA	W0285	H		H
VP04SMI	W0286	H		

B= Fecal coliform bacteria; H= Hydrolab meter (pH, temperature, dissolved oxygen, specific conductance); N= Nutrients (total phosphorus, ammonia nitrogen, nitrate nitrogen, total Kjeldahl nitrogen); W= Water chemistry (alkalinity, hardness, chloride, total suspended solids, turbidity); F= Flow measurement.

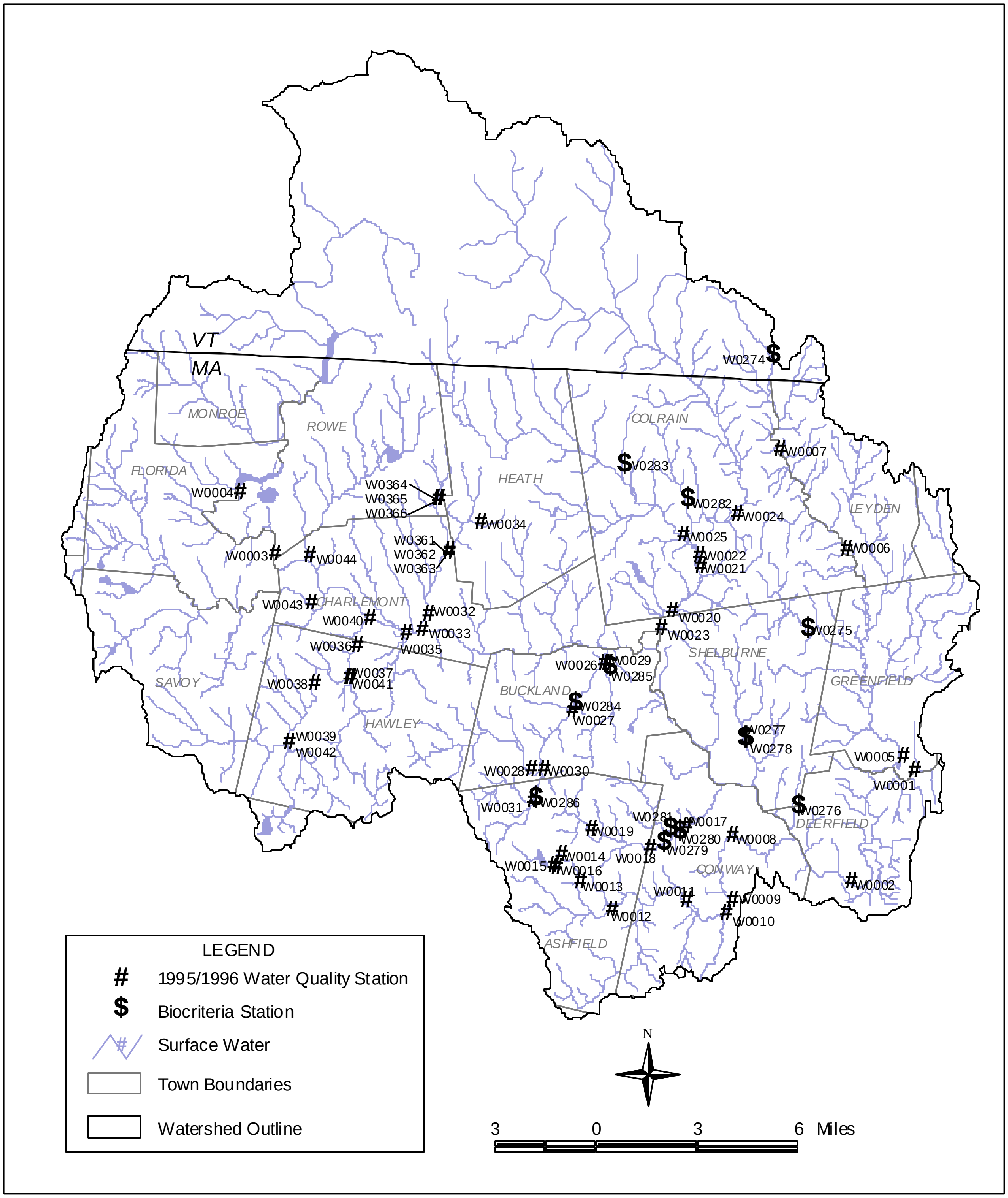

Figure G1. 1995/1996/1997 Biocriteria and Water Quality Monitoring Stations in the Deerfield River Watershed.

Table G2. 1995/1996 DWM Data Decisions for Deerfield River Watershed Discrete Sample Data (excerpted from MA DEP 2000).

OWMID	
33-0177-183 **33-0172**:	TKN had been analyzed outside of the established holding time of 28 days. Samples were collected on 6/19/96 and analyzed on 7/24/96. <u>Data censored</u>.
33-0164-171 **33-0160**:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 5/15/96 and analyzed on 6/6/96. <u>Data censored</u>.
33-0144-149:	Suspended Solids had been analyzed outside of the established holding time of 7 days (see condition “a”). Samples were collected on 4/11/96 and analyzed on 4/18/96. <u>Data censored</u>.
33-0130-137 **33-0126**:	TKN had been analyzed outside of the established holding time of 28 days. Samples were collected on 3/20/96 and analyzed on 4/18/96. <u>Data censored</u>.
33-0117-125:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 2/28/96 and analyzed on 3/14/96. <u>Data censored</u>.
33-111-116 **33-0109** **33-0101**:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 12/06/95 and analyzed on 12/22/95. <u>Data censored.</u>
33-0015-023:	Fecal Coliform had been analyzed outside of the established holding time of 6 hrs. Samples were collected on 7/20/95 and analyzed on 7/21/95. <u>Data censored.</u>
33-0007:	Failed to meet TKN, Ammonia and Nitrate field blank and field replicate data quality objectives for the 6/7/95 sampling survey. Since two data quality objectives were violated, all associated TKN, Ammonia and Nitrate data by that sampling crew on that day (**33-0001-0007)** are <u>censored.</u>

<u>Notes:</u>

1) The DWM QA Program was not fully established during the 1994, 95 and 96 sampling surveys. In addition, DWM relied on WES to supply the reagent water for field blanks. DWM staff members were not always supplied with contaminant-free reagent water. If the field blank objective was violated the associated survey data are not necessarily suspect unless a trend is found or there is documented evidence that aberrant collection, handling or analysis procedures were used. If, however, two or more data quality objectives were violated than all associated data by that sampling crew on that day are to be censored.

2) Statistically, slight differences between replicate values at or near a low MDL will result in an increase in relative percent difference (%RPD) values. This increase can create a false impression that replicate data are not meeting their set quality control limits. For replicate values at or near method detection limits ($\leq$1 mg/L), a 30% RPD data quality objective was applied to help counter this statistical effect. Replicate values > 1mg/L were reviewed independently against other quality control factors (i.e. field blank data, documentation) and a decision made on their validity.

Table G3. 1995/1996 Deerfield River Watershed *in-situ* Hydrolab® data.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
DEERFIELD RIVER									
Station: UD01, Mile Point: 38.9, Unique ID[2]: W0004									
Description: in Florida, approximately 800 feet below Fife Brook Dam									
33-0001	06/07/95	10:22	0.2	15.9	6.5	45	29.0	9.3	94
33-0008	07/06/95	10:42	0.3	20.0	6.7	45	29.0	8.3	90
33-0024	08/16/95	10:09	0.5	21.4	6.8	48	31.0	8.8	99
33-0041	09/13/95	09:59	0.2	17.5	7.0	47	30.0	9.1	95
33-0071	10/04/95	10:27	0.4	15.4	6.8	46	29.0	9.4	94
33-0084	11/08/95	09:30	**i	8.6	6.6	37	24.0	11.5	99
33-0138	04/11/96	09:22	0.4	3.4	**	50	32.0	12.1	92
33-0160	05/15/96	10:22	1.0	7.7	6.0	30	19.1	11.7	97
33-0172	06/19/96	10:32	**m	**m	**m	**m	**m	**m	**m
DEERFIELD RIVER									
Station: UD02, Mile Point: 33.5, Unique ID: W0003									
Description: approximately 1/4 mile above the Florida Bridge, this is an alternate station to UD01 used in December, February and March.									
33-0101	12/06/95	10:39	0.4	3.7	6.2	37	24.0	12.5	94
33-0117	02/28/96	10:08	**i	1.9	6.2	41	26.0	13.1	96
33-0126	03/20/96	09:59	**i	1.7	6.1	44	27.9	13.1	95
DEERFIELD RIVER									
Station: LD, Mile Point: 8, Unique ID: W0002									
Description: in Deerfield located approximately 2000 feet below Stillwater Bridge, sampled off south bank.									
33-0004	06/07/95	13:35	0.2	19.7	7.3	84	54.0	8.6	95
33-0012	07/06/95	14:12	0.3	26.2	8.3	90	58.0	8.7	106
33-0029	08/16/95	13:11	0.4	26.0	8.3	95	61.0	8.8	108
33-0048	09/13/95	13:44	0.4	17.5	7.4	72	46.0	9.4	97
33-0079	10/04/95	14:27	**i	15.1	7.4	74	47.0	9.7	96
33-0096	11/08/95	11:41	0.4	7.1	6.9	57	36.0	11.7	97
33-0114	12/06/95	10:59	**i	2.8	7.1	53	34.0	13.1	97
33-0121	02/28/96	12:22	0.9	2.6	7.0	57	36.4	13.0	97
33-0133	03/20/96	13:03	0.4	2.4	6.8	63	40.0	12.9	95
33-0146	04/11/96	12:59	**m	**m	**m	**m	**m	**m	**m
33-0167	05/15/96	14:07	0.8	8.7	6.8	45	28.9	11.8	99
33-0180	06/19/96	14:02	0.5	19.9	7.3	95	60.7	9.4	102
DEERFIELD RIVER									
Station: 5-10, Mile Point: 1.2, Unique ID: W0001									
Description: in Greenfield at (Route 5-10) Bridge located on downstream side of bridge over north channel of river.									
33-0050	09/13/95	15:02	1.1	18.1	7.2	102	65.0	9.5	100
33-0081	10/04/95	15:29	0.7	15.2	7.2	116	74.0	9.5	94
33-0099	11/08/95	13:17	0.4	7.1	6.9	66	42.0	11.8	99
33-0100	11/08/95	13:24	0.3	7.1	6.9	66	42.0	11.8	98
33-0116	12/06/95	12:17	**i	2.8	7.0	66	42.0	13.2	98
33-0124	02/28/96	13:26	0.4	3.1	6.8	67	42.8	13.0	98
33-0136	03/20/96	14:14	0.3	2.9	6.8	69	44.4	13.2	99
33-0149	04/11/96	13:50	0.6	6.0	7.2	90	57.8	12.5	102
33-0170	05/15/96	15:04	1.0	9.0	6.9	53	33.8	11.6	99
33-0183	06/19/96	14:57	0.5	20.0	7.1	104	66.3	8.8	96
GREEN RIVER									
Station: GR07, Mile Point: 14.2, Unique ID: W0007									
Description: in Colrain, at USGS gage #01170100 Station north of East Colrain									
33-0038	08/30/95	12:50	0.4	19.6	8.1	126	81.0	9.1	99

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number. ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
GREEN RIVER									
Station: GR08, Mile Point: 10, Unique ID[2]: W0006									
Description: at boat launch about 3/10 of a mile downstream from Browning Brook.									
33-0039	08/30/95	13:21	0.3	20.8	8.2	141	90.0	8.6	95
GREEN RIVER									
Station: GR, Mile Point: 0.8, Unique ID: W0005									
Description: in Greenfield, located at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP, on bridge during high flow and just downstream during low flow.									
33-0006	06/07/95	14:24	0.3	18.3	7.8	160	103	9.2	98
33-0014	07/06/95	14:45	0.3	25.0	8.5	169	108	9.8	117
33-0030	08/16/95	14:07	0.6	23.8	7.9	207	132	8.8	104
33-0040	08/30/95	13:51	0.4	21.9	8.2	202	129	9.6	109
33-0049	09/13/95	14:30	0.4	17.3	7.9	215	138	9.9	103
33-0080	10/04/95	15:00	**i	14.6	7.8	179	114	10.0	98
33-0097	11/08/95	12:46	0.3	6.3	7.1	108	69.0	12.4	101
33-0115	12/06/95	11:36	**i	1.8	7.5	145	93.0	13.4	96
33-0122	02/28/96	12:57	0.3	3.3	6.9	104	66.6	13.4	101
33-0134	03/20/96	13:32	0.3	2.9	6.9	119	76.0	13.4	100
33-0147	04/11/96	13:27	0.4	5.8	7.4	126	80.3	12.4	100
33-0168	05/15/96	14:34	1.2	10.1	7.2	103	65.6	11.6	102
33-0181	06/19/96	14:24	0.4	17.8	7.7	147	94.0	9.4	98
SOUTH RIVER									
Station: SO-1, Mile Point: 14.9, Unique ID: W0015									
Description: 75 feet downstream from first bridge crossing in downtown Ashfield of river exiting Ashfield Pond.									
33-0015	07/20/95	10:13	**i	19.9	6.8	232	148	5.3	58
SOUTH RIVER									
Station: SO-2, Mile Point: 14.8, Unique ID: W0016									
Description: at 2nd bridge crossing in downtown Ashfield off bridge, just below.									
33-0016	07/20/95	10:31	**i	18.6	6.9	240	153	5.0	53
SOUTH RIVER									
Station: SO-3, Mile Point: 14.2, Unique ID: W0014									
Description: in Ashfield, just downstream of bridge crossing at Baptist Corner Road, within 75 feet of bridge, sampled off bank.									
33-0017	07/20/95	10:52	**i	17.2	7.4	211	135	8.0	83
SOUTH RIVER									
Station: SO-4, Mile Point: 12.8, Unique ID: W0013									
Description: in Ashfield, at bridge crossing on Emmets Road just above bridge in stream.									
33-0018	07/20/95	11:10	**i	15.8	7.2	183	117	8.4	84
SOUTH RIVER									
Station: SO-5, Mile Point: 10.9, Unique ID: W0012									
Description: in Ashfield, located off Route 116 about 400 feet downstream from the Bullitt Road bridge, in stream.									
33-0019	07/20/95	11:27	**i	17.2	8.0	188	120	8.8	91
SOUTH RIVER									
Station: SO-6, Mile Point: 7.3, Unique ID: W0011									
Description: in Conway located at 2nd Route 116 bridge crossing of South River after crossing town line from Ashfield near Riley Road, just below bridge, sampled from bank.									
33-0020	07/20/95	13:47	0.2	21.5	8.0	159	102	8.8	100
SOUTH RIVER									
Station: SO-7, Mile Point: 5.7, Unique ID: W0010									
Description: in downtown Conway at bridge on Route 116, waded instream just below bridge.									
33-0021	07/20/95	14:14	0.3	22.0	8.4	164	105	8.9	102

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
SOUTH RIVER									
Station: SO-8, Mile Point: 5.1, Unique ID[2]: W0009									
Description: at bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway									
33-0022	07/20/95	14:30	0.2	23.3	8.6	166	106	8.9	104
SOUTH RIVER									
Station: SO, Mile Point: 2.7, Unique ID: W0008									
Description: in Conway (located at USGS Gaging Station) at Reeds Bridge, just off Bardwell Road just above bridge.									
33-0003	06/07/95	12:50	**i	17.2	7.8	145	92.0	9.2	96
33-0011	07/06/95	13:35	0.1i	24.0	8.4	180	115	8.7	102
33-0023	07/20/95	14:52	0.2	23.6	8.3	161	103	8.3	97
33-0027	08/16/95	12:25	0.3	22.3	8.3	193	124	9.3	107
33-0046	09/13/95	13:07	0.3	15.5	7.9	202	130	9.7	96
33-0077	10/04/95	13:48	**i	13.3	7.7	181	116	9.3	89
33-0095	11/08/95	10:54	0.3	6.3	7.1	97	62.0	11.7	95
33-0113	12/06/95	10:23	**i	1.6	7.4	110	70.0	13.4	95
33-0120	02/28/96	11:51	0.2	3.2	7.1	94	60.0	12.9	98
33-0132	03/20/96	12:34	0.1i	2.4	6.8	81	51.8	13.2	98
33-0145	04/11/96	12:31	0.2	7.0	7.5	116	74.1	12.0	101
33-0166	05/15/96	13:37	0.5	10.8	7.2	102	65.0	10.8	96
33-0179	06/19/96	13:33	0.3	16.4	7.6	136	87.2	9.6	98
BEAR RIVER									
Station: BR03, Mile Point: 5.8, Unique ID: W0019									
Description: in Ashfield at Baptist Corner Road bridge just below golf course.									
33-0068	09/27/95	13:16	0.1i	14.4	7.5	201	129	10.4	101
BEAR RIVER									
Station: BR02, Mile Point: 3.5, Unique ID: W0018									
Description: in Ashfield, just downstream of bridge at Pfersick Road, instream.									
33-0069	09/27/95	13:48	0.4	13.1	7.8	152	97.0	10.6	101
BEAR RIVER									
Station: BE, Mile Point: 1.9, Unique ID: W0017									
Description: in Conway, located approximately 250 feet upstream from bridge on Shelburne Falls Road, sampled instream just above unnamed tributary.									
33-0010	07/06/95	13:06	0.1i	19.3	8.2	140	90.0	9.3	100
33-0026	08/16/95	11:52	0.3	19.5	8.1	151	96.0	9.2	100
33-0045	09/13/95	12:14	0.2	13.1	7.8	145	93.0	10.0	95
33-0070	09/27/95	14:11	0.4	12.8	7.9	142	91.0	10.1	95
33-0076	10/04/95	13:23	**i	11.3	7.7	135	86.0	10.1	92
33-0094	11/08/95	10:15	0.2	5.8	7.4	93	60.0	12.0	96
33-0112	12/06/95	09:56	**i	1.7	7.5	95	61.0	13.5	97
33-0119	02/28/96	11:20	**i	2.2	7.2	79	50.4	13.1	97
33-0131	03/20/96	12:13	0.2	1.6	6.9	73	46.9	13.3	96
33-0144	04/11/96	12:12	0.1i	4.9	7.3	89	56.8	12.2	97
33-0165	05/15/96	13:13	0.5	9.8	7.3	85	54.4	11.0	95
33-0178	06/19/96	13:12	0.2	15.4	7.7	110	70.1	9.8	97
NORTH RIVER									
Station: NR04, Mile Point: 3, Unique ID: W0022									
Description: Adamsville Road bridge, Colrain, west bank, under bridge, upstream.									
33-0035	08/30/95	10:46	0.4	17.3	7.2	125	80.0	9.0	93
NORTH RIVER									
Station: NR03, Mile Point: 2.6, Unique ID: W0021									
Description: in Colrain, Route 112 bridge just south of Griswoldville, under bridge, upstream from south bank.									
33-0034	08/30/95	10:24	0.3	20.7	7.5	946	606	9.0	100

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Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
NORTH RIVER									
Station: NO, Mile Point: 0.8, Unique ID[2]: W0020									
Description: in Colrain, located approximately 3/10 of a mile below USGS Gaging Station at Shattuckville and 500 feet above bridge on Route 112 from the north bank.									
33-0002	06/07/95	11:40	**i	17.3	7.8	152	98.0	9.5	100
33-0009	07/06/95	11:48	0.2	23.0	8.2	186	119	8.9	102
33-0025	08/16/95	11:10	0.4	22.7	8.1	213	136	9.0	103
33-0033	08/30/95	09:59	0.4	17.1	7.8	456	292	9.3	95
33-0044	09/13/95	11:38	0.4	16.2	8.1	520	333	9.6	97
33-0075	10/04/95	12:27	**i	14.3	8.1	399	255	10.6	103
33-0092	11/08/95	12:04	**i	6.1	7.2	75	48.0	12.4	100
33-0109	12/06/95	14:08	0.4	2.1	6.9	105	67.0	13.3	96
33-0118	02/28/96	10:53	0.3	2.6	7.0	75	48.0	13.5	100
33-0130	03/20/96	11:31	**m	**m	**m	**m	**m	**m	**m
33-0143	04/11/96	11:14	0.4	4.7	7.4	93	59.4	12.7	100
33-0164	05/15/96	12:04	0.7	9.0	6.9	69	44.0	11.8	100
33-0177	06/19/96	12:29	0.3	17.1	7.6	139	88.9	9.8	101
EAST BRANCH NORTH RIVER									
Station: EBNR06, Mile Point: 2.4, Unique ID: W0024									
Description: in Colrain, about 700 feet upstream from bridge just north of downtown Colrain on Route 112, sampled from south bank on access road.									
33-0037	08/30/95	11:43	0.4	15.5	7.4	143	92.0	9.7	96
WEST BRANCH NORTH RIVER									
Station: WBNR05, Mile Point: 0.7, Unique ID: W0025									
Description: in Colrain just upstream from bridge across from the Branch Cemetery on Adamsville Road, sampled from north bank in middle of 6 to 8 foot wide stream.									
33-0036	08/30/95	11:06	0.3	17.5	7.7	94	60.0	8.9	93
CLESSON BROOK									
Station: SH01, Mile Point: 5, Unique ID: W0028									
Description: in Ashfield, about 0.5 miles upstream from confluence with Smith Brook near Hawley Road bridge, instream above bridge.									
33-0066	09/27/95	11:46	0.1i	13.1	7.7	76	49.0	10.0	94
CLESSON BROOK									
Station: CL02, Mile Point: 2.4, Unique ID: W0027									
Description: in Buckland, approximately 200 yards downstream from Hog Hollow Road bridge off Route 112.									
33-0064	09/27/95	10:52	0.2	12.4	8.0	152	97.0	10.3	96
CLESSON BROOK									
Station: CL, Mile Point: 0.5, Unique ID: W0026									
Description: in Buckland, located at bridge on Route 112 northeast of Depot Road, off west bank just above bridge.									
33-0063	09/27/95	10:21	0.2	12.5	7.9	154	99.0	10.5	98
33-0074	10/04/95	12:03	**i	12.7	7.8	156	100	10.1	95
33-0090	11/08/95	11:32	**i	6.7	7.2	87	56.0	11.3	93
33-0108	12/06/95	13:42	0.3	1.5	7.0	66	42.0	13.6	96
33-0129	03/20/96	11:11	0.1i	2.1	7.0	79	50.2	13.1	96
33-0141	04/11/96	10:43	0.2	5.4	7.5	106	67.9	12.3	99
33-0157	04/24/96	12:13	**i	9.3	7.0	74	47.2	10.9	96
33-0162	05/15/96	11:29	0.4	9.5	7.0	90	57.9	11.4	98
33-0175	06/19/96	11:58	0.3	16.5	7.7	128	81.6	9.2	93

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Table G3 continued.

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CLARK BROOK									
Station: CK, Mile Point: 0.2, Unique ID[2]: W0029									
Description: in Buckland, located at bridge on Route 112, approximately 200 feet east of Clesson Brook, from north bank just above bridge.									
33-0091	11/08/95	11:44	**i	6.1	7.4	65	42.0	12.0	97
33-0107	12/06/95	13:26	0.4	3.0	6.8	97	62.0	12.7	95
33-0142	04/11/96	10:55	0.2	3.2	7.2	73	46.8	12.8	97
33-0158	04/24/96	12:00	**i	7.4	7.2	59	37.6	11.6	97
33-0163	05/15/96	11:41	0.5	7.5	6.9	61	39.3	11.9	98
33-0176	06/19/96	12:10	0.3	15.3	7.6	82	52.6	9.5	94
SMITH BROOK									
Station: CL03, Mile Point: 0.0, Unique ID: W0030									
Description: at Buckland four corners, just upstream of confluence with Clesson Brook, instream .									
33-0065	09/27/95	11:20	0.2	12.6	7.9	192	123	10.6	100
UPPER BRANCH									
Station: UB01, Mile Point: 0.2, Unique ID: W0031									
Description: in Ashfield above bridge on Apple Valley Road near gravel pit, instream.									
33-0067	09/27/95	12:12	0.1i	12.1	7.8	125	80.0	10.2	94
MILL BROOK									
Station: MB-A, Mile Point: 2.7, Unique ID: W0363									
Description: just upstream of the confluence with Davis Mine Brook, Charlemont.									
33-0187	07/17/96	12:49	0.1i	16.9	7.3	53	34.0	9.2	95
MILL BROOK									
Station: MB-B, Mile Point: 2.69, Unique ID: W0361									
Description: just downstream of the confluence with Davis Mine Brook, Charlemont.									
33-0185	07/17/96	12:21	0.2	16.6	7.2	50	31.7	9.4	95
MILL BROOK									
Station: MIL2, Mile Point: 0.5, Unique ID: W0032									
Description: about 300 feet above covered bridge in Charlemont, instream.									
33-0061	09/27/95	14:10	**i	14.7	7.4	88	57.0	9.8	96
MILL BROOK									
Station: MI, Mile Point: 0.0, Unique ID: W0033									
Description: in Charlemont, located at mouth of brook within 20 feet of confluence of Deerfield River, instream .									
33-0060	09/27/95	13:48	**i	13.9	7.7	90	58.0	9.9	95
33-0089	11/08/95	11:02	**i	5.9	7.1	49	31.0	12.1	97
33-0106	12/06/95	12:59	0.2	2.1	6.5	62	40.0	13.0	94
33-0159	04/24/96	11:32	**i	6.7	6.5	35	22.2	11.6	96
DAVIS MINE BROOK									
Station: DMB-1, Mile Point: 1.71, Unique ID: W0366									
Description: just upstream of the Davis Mine drainage, Rowe.									
33-0190	07/17/96	14:41	**i	19.4	6.4	33	21.3	8.4	91
Pipe/Discharge to DAVIS MINE BROOK									
Station: UKN, Mile Point: 1.7, Unique ID: W0364									
Description: "Davis Mine" drainage, Rowe.									
33-0188	07/17/96	14:25	**i	23.7	3.0	772	494	7.1	84
DAVIS MINE BROOK									
Station: DMB-2, Mile Point: 1.69, Unique ID: W0365									
Description: just downstream of the Davis Mine drainage, Rowe.									
33-0189	07/17/96	14:35	**i	20.2	3.7	176	113	7.9	87

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Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
DAVIS MINE BROOK									
Station: DMB-B, Mile Point: 0.01, Unique ID[2]: W0362									
Description: just upstream of the confluence with Mill Brook, Charlemont.									
33-0186	07/17/96	12:33	0.1i	16.4	6.5	46	29.6	9.3	94
HEATH BROOK									
Station: MIL3, Mile Point: 0.2, Unique ID: W0034									
Description: in Heath on Heath Brook approx. 2/10 mile from confluence with Mill Brook off Dell Road, instream.									
33-0062	09/27/95	14:33	**i	11.5	7.7	95	61.0	10.0	92
BOZRAH BROOK									
Station: BO, Mile Point: 0.0, Unique ID: W0035									
Description: in Charlemont, located off South River Road near the entrance to Berkshire East Ski Area, instream, 75 feet upstream from bridge.									
33-0059	09/27/95	13:17	**i	15.2	7.4	97	62.0	9.3	93
33-0088	11/08/95	10:48	**i	6.2	6.9	52	33.0	11.5	94
33-0105	12/06/95	12:05	0.3	2.1	6.4	54	35.0	13.0	94
33-0155	04/24/96	11:14	**i	7.0	6.7	39	25.1	11.3	94
CHICKLEY RIVER									
Station: CH5, Mile Point: 5.5, Unique ID: W0039									
Description: 100 feet downstream of Route 8A bridge in West Hawley above confluence of King Brook, instream.									
33-0056	09/27/95	11:48	**i	10.9	7.3	47	30.0	10.5	94
CHICKLEY RIVER									
Station: CH4, Mile Point: 3.3, Unique ID: W0038									
Description: in Hawley, due west of Forge Hill.									
33-0055	09/27/95	11:09	**i	11.3	7.3	52	33.0	10.5	96
CHICKLEY RIVER									
Station: CH3, Mile Point: 1.7, Unique ID: W0037									
Description: just above confluence with Mill Brook, instream.									
33-0054	09/27/95	10:41	**i	11.6	7.5	56	36.0	10.6	97
CHICKLEY RIVER									
Station: CH7, Mile Point: 0.6, Unique ID: W0036									
Description: in Hawley, across from farm just upstream from 2nd bridge on Route 8A upstream from confluence with the Deerfield.									
33-0058	09/27/95	12:29	**i	13.0	7.9	67	43.0	10.4	99
CHICKLEY RIVER									
Station: CH, Mile Point: 0.0, Unique ID: W0040									
Description: in Charlemont located upstream of bridge on Tower Road between Routes 2 and 8A, approximately 100 feet from Deerfield River, instream except during high flow.									
33-0043	09/13/95	10:56	0.3	13.9	7.9	70	45.0	10.3	99
33-0052	09/27/95	09:56	0.1i	11.9	7.8	66	43.0	10.8	99
33-0073	10/04/95	11:23	**i	12.0	7.5	67	43.0	10.3	95
33-0087	11/08/95	10:30	**i	5.7	7.0	36	23.0	12.3	99
33-0104	12/06/95	11:47	0.3	1.3	6.4	39	25.0	13.7	97
33-0128	03/20/96	10:43	0.1i	1.6	7.0	35	22.4	13.3	97
33-0140	04/11/96	10:08	**m	**m	**m	**m	**m	**m	**m
33-0154	04/24/96	10:52	**i	7.0	6.5	26	16.3	11.5	95
33-0161	05/15/96	10:56	0.4	7.7	6.5	32	20.3	11.9	98
33-0174	06/19/96	11:28	0.2	15.7	7.6	45	28.8	10.1	100
MILL BROOK									
Station: CH2, Mile Point: 0.0, Unique ID: W0041									
Description: Mill Brook just above confluence with the Chickley River, instream.									
33-0053	09/27/95	10:31	**i	11.3	7.6	93	59.0	10.5	96

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KING BROOK									
Station: CH6, Mile Point: 0.0, Unique ID[2]: W0042									
Description: in Hawley in King Brook at confluence with Chickley River.									
33-0057	09/27/95	11:56	**i	10.8	7.0	43	27.0	10.0	90
COLD RIVER									
Station: CO, Mile Point: 0.8, Unique ID: W0043									
Description: in Florida, located at bridge to entrance to Mohawk Trail State Forest Campgrounds off Route 2 (approximately 1.35 miles above the mouth).									
33-0042	09/13/95	10:35	0.1i	14.7	7.4	97	62.0	9.8	95
33-0072	10/04/95	11:04	**i	12.4	7.4	87	56.0	10.2	96
33-0086	11/08/95	10:13	**i	5.1	6.8	39	25.0	12.3	97
33-0103	12/06/95	11:27	0.2	0.70	**	52	33.0	13.6	95
33-0127	03/20/96	10:25	0.1i	0.72	6.9	84	53.7	13.6	96
33-0139	04/11/96	09:54	0.1i	3.1	7.0	96	61.2	13.0	98
33-0152	04/24/96	10:32	**i	5.9	6.3	32	20.2	11.7	95
33-0173	06/19/96	11:07	0.2	17.4	7.2	62	39.5	9.4	97
PELHAM BROOK									
Station: PE, Mile Point: 0.0, Unique ID: W0044									
Description: in Charlemont located at bridge off Zoar Road, just above bridge, south side, instream.									
33-0085	11/08/95	09:54	**i	5.3	6.6	33	21.0	12.3	98
33-0102	12/06/95	11:04	0.3	1.4	6.2	33	21.0	13.5	96
33-0151	04/24/96	10:17	0.1i	7.0	6.0	23	14.7	11.7	97
UNNAMED TRIBUTARY									
Station: VP06ROA, Mile Point: 0.1, Unique ID: W0274									
Description: Guilford, Vermont; Roaring Brook approximately 200 meters northwest (upstream) of Green River Road.									
BC-0010	09/25/96	10:47	** i	10.3	7.7	83.8	53.7	10.0	90
BC-0058	10/08/97	09:36	0.1i	8.7	7.7	92.0	59.0	11.7	98
HINSDALE BROOK									
Station: VP05HIN, Mile Point: 2, Unique ID: W0275									
Description: Shelburne, approximately 700 meters south (downstream) of Wilson Graves Road off the west side of Greenfield Road (Brook Road).									
BC-0009	09/25/96	08:28	**i	11.4	7.9	178	114	10.1	92
SHINGLE BROOK									
Station: VP02SHN, Mile Point: 0.7, Unique ID: W0276									
Description: Deerfield, west of Hawks Road approximately 200 meters south (downstream) of Shelburne/Deerfield border.									
BC-0006	09/24/96	13:31	**i	12.0	7.3	203	130	9.5	88
DRAGON BROOK									
Station: 277, Mile Point: 1.5, Unique ID: W0277									
Description: Shelburne, on the north (upstream) side of the intersection of Allen Road, South Shelburne Road and Bardwell Ferry Road (Orchard Road).									
BC-0004	09/24/96	11:18	**i	10.7	7.7	158	101	9.7	88
DRAGON BROOK									
Station: VP01DRG, Mile Point: 1.49, Unique ID: W0278									
Description: Shelburne, approximately 50 meters south (downstream) of the intersection of Allen Road, South Shelburne Road and Bardwell Ferry Road (Orchard Road).									
BC-0005	09/24/96	11:40	**i	10.9	7.7	162	104	9.8	89
BEAR RIVER									
Station: VP12BEA, Mile Point: 2.8, Unique ID: W0279									
Description: Conway, off the west side of Pine Hill Road approximately 700 meters south/southwest (upstream) of Drakes Brook confluence.									
BC-0002	09/17/96	13:14	**i	13.4	7.8	134	85.8	9.6	91
BC-0055	09/25/97	12:25	**i	8.3	7.9	135	86.0	11.6	96

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BEAR RIVER									
Station: VP11BEA, Mile Point: 2.2, Unique ID[2]: W0280									
Description: Conway, off the northwest side of Shelburne Falls Road just northeast (downstream) of the Pea Brook confluence.									
BC-0003	09/17/96	17:37	**i	13.6	7.8	122	77.9	9.4	90
BC-0056	09/25/97	15:12	**i	9.7	7.9	129	83.0	11.2	96
DRAKES BROOK									
Station: VP13DRK, Mile Point: 0.2, Unique ID: W0281									
Description: Conway, approximately 300 meters above/north of confluence with Bear River.									
BC-0001	09/17/96	09:37	**i	14.3	7.7	104	66.5	9.6	94
BC-0054	09/25/97	10:44	**i	7.5	7.7	105	67.0	11.8	96
FOUNDRY BROOK									
Station: VP07FOU, Mile Point: 0.6, Unique ID: W0282									
Description: Colrain, west of York Road approximately 1000 meters north of confluence with East Branch North River.									
BC-0011	09/17/96	13:35	**i	11.0	7.7	136	86.9	9.5	86
BC-0059	10/08/97	11:42	**i	9.5	7.6	138	89.0	11.0	94
TISSDELL BROOK									
Station: VP08TIS, Mile Point: 0.5, Unique ID: W0283									
Description: Colrain, approximately 700 meters north (upstream) of Adamsville Road.									
BC-0012	09/25/96	15:23	**i	10.4	7.5	80.7	51.7	9.6	86
BC-0060	10/08/97	13:12	**i	10.1	7.6	81.3	52.0	11.0	95
CLESSON BROOK									
Station: VP10CLE, Mile Point: 2.2, Unique ID: W0284									
Description: Buckland, approximately 500 meters north (downstream) of Hog Hollow Road off the east side of Route 112.									
BC-0013	09/26/96	09:52	**i	9.2	7.4	111	71.0	11.1	96
CLARK BROOK									
Station: VP09CLA, Mile Point: 0.3, Unique ID: W0285									
Description: Buckland, approximately 400 meters south (upstream) of Route 112.									
BC-0014	09/26/96	12:43	**i	9.6	7.5	83.9	53.7	11.1	97
BC-0061	10/08/97	15:05	**i	10.5	7.6	93.0	60.0	11.1	97
SMITH BROOK									
Station: VP04SMI, Mile Point: 1, Unique ID: W0286									
Description: Ashfield, approximately 100 meters north (downstream) of the Upper Branch confluence off the west side of Apple Valley Road.									
BC-0008	09/24/96	17:35	**i	11.3	7.5	110	70.4	9.3	85

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data,
i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G4. 1995/1996 Deerfield River Watershed Water Quality Data. Units are mg/L unless otherwise expressed.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
DEERFIELD RIVER													
Station: UD01, Unique ID[2]: W0004, Description: in Florida, approximately 800 feet below Fife Brook Dam.													
33-0001		06/07/95	10:20	<1.0	5.4	--	10	<2.5	**	**	**	<0.05	20
33-0008		07/06/95	10:43	7.0	7.0	--	6.0	<2.5	<0.10	0.02	0.16	0.02	20
33-0024		08/16/95	10:08	6.0	6.0	50	5.0	<2.5	0.14	<0.02	0.18	0.03	60
33-0041		09/13/95	10:00	8.0	11	--	6.0	<2.5	0.14	<0.02	0.22	<0.01	<20
33-0071		10/04/95	10:28	6.0	3.2	45	5.0	<2.5	0.13	0.02	0.23	0.01	20
33-0084		11/08/95	9:30	4.0	6.1	--	3.0	<2.5	0.16	0.04	0.13	0.02	76
33-0138		04/11/96	9:23	--	--	--	--	--	--	--	--	--	<2
33-0160		05/15/96	10:22	4.0	**	--	3.0	<2.5	0.14	<0.02	0.21	0.02	10
33-0172		06/19/96	10:35	5.0	5.0	--	8.0	<2.5	**	<0.02	0.11	<0.01	<9
DEERFIELD RIVER													
Station: UD02, Unique ID: W0003, Description: approximately 1/4 mile above the Florida bridge, this is an alternate station to UD01 used in December February and March.													
33-0101		12/06/95	10:40	5.0	**	--	3.0	<2.5	0.12	<0.02	0.16	0.02	7
33-0117		02/28/96	10:08	5.0	**	--	4.0	<2.5	**	<0.02	0.26	0.02	<2
33-0126		03/20/96	9:59	5.0	8.1	--	9.0	<2.5	**	0.02	0.25	0.01	4
DEERFIELD RIVER													
Station: LD, Unique ID: W0002, Description: in Deerfield located approximately 2000 feet below Stillwater Bridge, sampled off south bank.													
33-0004	33-0005	06/07/95	13:40	**	25	--	6.0	<2.5	**	**	**	<0.05	178
33-0005	33-0004	06/07/95	13:40	**	25	--	9.0	<2.5	**	**	**	<0.05	--
33-0012		07/06/95	14:13	--	14	--	--	--	0.10	<0.02	0.14	0.02	140
33-0029		08/16/95	13:11	19	14	92	6.0	<2.5	0.13	<0.02	0.15	0.03	90
33-0048		09/13/95	13:44	13	20	--	6.0	<2.5	0.13	<0.02	0.24	0.01	100
33-0079		10/04/95	14:27	13	5.8	--	7.0	<2.5	0.10	<0.02	0.18	0.01	90
33-0096		11/08/95	11:41	13	8.7	--	3.0	<2.5	0.15	<0.02	0.21	0.02	350
33-0114		12/06/95	11:00	16	**	--	3.0	<2.5	<0.10	<0.02	0.25	0.02	33
33-0121		02/28/96	12:22	10	**	--	5.0	<2.5	<0.10	<0.02	0.27	0.02	19
33-0133		03/20/96	13:03	12	18	--	6.0	20	**	0.04	0.31	0.07	**
33-0146		04/11/96	13:01	13	7.9	--	20	**	<0.10	<0.02	0.23	0.03	19
33-0167		05/15/96	14:02	9.0	**	--	4.0	3.0	<0.10	<0.02	0.25	0.02	20
33-0180		06/19/96	14:02	22	17	--	5.0	<2.5	**	<0.02	0.20	0.01	240

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
DEERFIELD RIVER													
Station: 5-10, Unique ID[2]: W0001, Description: in Greenfield at (Route 5-10) Bridge located on downstream side of bridge over north channel of river.													
33-0050		09/13/95	15:03	20	27	--	10	<2.5	0.40	0.11	0.41	0.10	70
33-0082		10/04/95	**	--	--	--	--	--	--	--	--	--	560
33-0081		10/04/95	15:29	27	10	--	11	4.0	0.59	0.21	0.38	0.16	160
33-0099		11/08/95	13:17	15	10	--	4.0	6.0	0.18	<0.02	0.25	0.03	1,560
33-0116		12/06/95	12:17	12	**	--	6.0	<2.5	0.19	0.03	0.29	0.02	900
33-0124		02/28/96	13:26	13	**	--	5.0	4.0	<0.10	0.02	0.30	0.03	340
33-0136		03/20/96	14:14	15	21	--	7.0	31	**	0.04	0.29	0.09	--
33-0149		04/11/96	13:50	16	9.6	--	8.0	**	0.69	0.03	0.29	0.03	10
33-0170		05/15/96	15:04	11	**	--	4.0	3.0	0.11	<0.02	0.21	0.02	16
33-0183		06/19/96	14:57	24	19	--	8.0	3.0	**	0.08	0.36	0.03	72
GREEN RIVER													
Station: GR, Unique ID: W0005, Description: in Greenfield, located at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP, on bridge during high flow and just downstream during low flow.													
33-0006		06/07/95	14:20	45	61	--	10	<2.5	**	**	**	<0.05	300
33-0014		07/06/95	14:46	65	29	--	12	<2.5	0.10	0.03	0.13	0.02	2,600
33-0030		08/16/95	14:07	50	36	201	22	6.0	0.22	0.02	0.34	0.05	3,000
33-0040		08/30/95	13:50	--	--	--	--	--	--	--	--	--	**
33-0049		09/13/95	14:30	58	67	--	22	<2.5	0.15	<0.02	0.31	0.02	1,300
33-0080		10/04/95	15:00	47	18	--	18	4.0	0.17	0.03	0.29	0.04	560
33-0097		11/08/95	12:48	32	17	--	6.0	10	0.18	<0.02	0.29	0.03	130
33-0115		12/06/95	11:37	35	**	--	16	<2.5	<0.10	<0.02	0.40	0.01	60
33-0122	33-0123	02/28/96	12:57	27	**	--	8.0	15	<0.10	<0.02	0.39	0.05	58
33-0123	33-0122	02/28/96	12:57	26	**	--	8.0	14	<0.10	<0.02	0.38	0.06	--
33-0134	33-0135	03/20/96	13:32	28	42	--	11	55	**	0.07	0.39	0.13	80
33-0135	33-0134	03/20/96	13:32	28	42	--	11	59	**	0.02	0.38	0.14	--
33-0147	33-0148	04/11/96	13:27	29	16	--	11	**	<0.10	0.02	0.28	0.03	44
33-0148	33-0147	04/11/96	13:27	29	15	--	11	**	<0.10	0.02	0.28	0.03	--
33-0168	33-0169	05/15/96	14:33	29	**	--	7.0	7.0	<0.10	<0.02	0.20	0.02	80
33-0169	33-0168	05/15/96	14:33	29	**	--	8.0	8.0	0.16	<0.02	0.20	0.02	--
33-0181	33-0182	06/19/96	14:24	42	29	--	32	<2.5	**	0.02	0.28	<0.01	170
33-0182	33-0181	06/19/96	14:24	41	30	--	11	<2.5	**	<0.02	0.27	<0.01	230

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
GREEN RIVER													
Station: GR07, Unique ID[2]: W0007, Description: in Colrain at USGS Gaging Station just north of East Colrain.													
33-0038		08/30/95	12:50	--	--	--	--	--	--	--	--	--	**
GREEN RIVER													
Station: GR08, Unique ID: W0006, Description: at boat launch about 3/10 of a mile downstream from Browning Brook.													
33-0039		08/30/95	13:20	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-1, Unique ID: W0015, Description: 75 feet downstream from first bridge crossing in downtown Ashfield of river exiting Ashfield Pond.													
33-0015		07/20/95	10:13	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-2, Unique ID: W0016, Description: at 2nd bridge crossing in downtown Ashfield off bridge, just below.													
33-0016		07/20/95	10:32	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-3, Unique ID: W0014, Description: in Ashfield, just downstream of bridge crossing at Baptist Corner Road, within 75 feet of bridge, sampled off bank.													
33-0017		07/20/95	10:53	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-4, Unique ID: W0013, Description: in Ashfield, at bridge crossing on Emmets Road just above bridge in stream.													
33-0018		07/20/95	11:10	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-5, Unique ID: W0012, Description: in Ashfield, located off Route 116 about 400 feet downstream from the Bullitt Road bridge, in stream.													
33-0019		07/20/95	11:28	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-7, Unique ID: W0010, Description: in downtown Conway at bridge on Route 116, waded instream just below bridge.													
33-0021		07/20/95	14:14	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-8, Unique ID: W0009, Description: in Conway at bridge between Shelburne Falls Road and Reeds Bridge Road just below bridge, sampled instream.													
33-0022		07/20/95	14:31	--	--	--	--	--	--	--	--	--	**

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Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
SOUTH RIVER													
Station: SO, Unique ID[2]: W0008, Description: in Conway (located at USGS Gaging Station) at Reeds Bridge, just off Bardwell Road just above bridge.													
33-0003		06/07/95	12:30	**	83	--	12	<2.5	**	**	**	<0.05	540
33-0011		07/06/95	13:35	--	29	--	18	<2.5	<0.10	0.03	0.30	0.02	350
33-0023		07/20/95	14:53	--	--	--	--	--	--	--	--	--	**
33-0027	33-0028	08/16/95	12:27	54	34	184	17	<2.5	0.11	<0.02	0.26	0.03	160
33-0028	33-0027	08/16/95	12:37	53	34	192	17	<2.5	<0.10	<0.02	0.26	0.03	120
33-0046	33-0047	09/13/95	13:08	55	66	--	21	<2.5	0.10	<0.02	0.42	0.01	80
33-0047	33-0046	09/13/95	13:08	68	66	--	21	<2.5	0.11	<0.02	0.41	<0.01	<20
33-0077	33-0078	10/04/95	13:48	51	17	--	16	<2.5	<0.10	<0.02	0.29	0.02	85
33-0078	33-0077	10/04/95	13:48	51	17	--	16	<2.5	0.12	<0.02	0.31	0.03	--
33-0095		11/08/95	10:54	28	15	--	6.0	4.0	0.14	<0.02	0.30	0.02	360
33-0113		12/06/95	10:23	29	**	--	9.0	<2.5	<0.10	<0.02	0.51	0.01	330
33-0120		02/28/96	11:51	23	**	--	7.0	<2.5	<0.10	<0.02	0.39	0.02	125
33-0132		03/20/96	12:34	21	28	--	7.0	39	**	0.03	0.33	0.13	184
33-0145		04/11/96	12:31	26	13	--	16	**	0.14	<0.02	0.25	0.05	8
33-0166		05/15/96	13:37	27	**	--	8.0	<2.5	<0.10	<0.02	0.25	0.02	20
33-0179		06/19/96	13:34	38	26	--	17	<2.5	**	<0.02	0.42	<0.01	120
BEAR RIVER													
Station: BR03, Unique ID: W0019, Description: in Ashfield at Baptist Corner Road bridge just below golf course.													
33-0068		09/27/95	13:16	--	--	--	--	--	--	--	--	--	75
BEAR RIVER													
Station: BR02, Unique ID: W0018, Description: in Ashfield, just downstream of bridge at Pfersick Road, instream.													
33-0069		09/27/95	13:48	--	--	--	--	--	--	--	--	--	240

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
BEAR RIVER													
Station: BE, Unique ID[2]: W0017, Description: in Conway, located approximately 250 feet upstream from bridge on Shelburne Falls Road, sampled instream just above unnamed tributary.													
33-0010		07/06/95	13:07	--	32	--	--	--	<0.10	0.02	0.24	0.01	200
33-0026		08/16/95	11:52	55	34	150	4.0	<2.5	<0.10	<0.02	0.27	0.03	90
33-0045		09/13/95	12:15	55	61	--	3.0	<2.5	0.15	<0.02	0.24	0.03	60
33-0070		09/27/95	14:10	--	--	--	--	--	--	--	--	--	55
33-0076		10/04/95	13:23	50	16	--	4.0	<2.5	<0.10	0.02	0.18	0.02	110
33-0094		11/08/95	10:16	30	16	--	1.0	<2.5	<0.10	<0.02	0.17	0.02	80
33-0112		12/06/95	9:56	33	**	--	2.0	<2.5	<0.10	<0.02	0.23	0.01	15
33-0119		02/28/96	11:20	27	**	--	2.0	4.0	<0.10	<0.02	0.26	0.02	34
33-0131		03/20/96	12:13	24	2.4	--	2.0	18	**	0.03	0.28	0.06	44
33-0144		04/11/96	12:12	27	12	--	4.0	**	<0.10	<0.02	0.18	0.02	4
33-0165		05/15/96	13:12	31	**	--	<1.0	<2.5	<0.10	<0.02	0.11	0.01	19
33-0178		06/19/96	13:13	43	26	--	1.0	<2.5	**	<0.02	0.33	<0.01	64
NORTH RIVER													
Station: NR04, Unique ID: W0022, Description: in Colrain, bridge just north of Griswoldville on Adamsville Road, west bank, under bridge, upstream.													
33-0035		08/30/95	10:50	--	--	--	--	--	--	--	--	--	<100
NORTH RIVER													
Station: NR03, Unique ID: W0021, Description: in Colrain, Route 112 bridge just south of Griswoldville, under bridge, upstream from south bank.													
33-0034		08/30/95	10:20	--	--	--	--	--	--	--	--	--	800

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
NORTH RIVER													
Station: NO, Unique ID[2]: W0020, Description: in Colrain, located approximately 3/10 of a mile below USGS Gaging Station at Shattuckville and 500 feet above bridge on Route 112 from the north bank.													
33-0002		06/07/95	11:40	32	38	--	**	<2.5	**	**	**	<0.05	208
33-0009		07/06/95	11:49	--	25	--	10	<2.5	0.25	0.03	0.77	0.07	920
33-0025		08/16/95	11:10	37	23	207	10	<2.5	0.24	<0.02	0.16	0.04	1,726
33-0033		08/30/95	10:00	--	--	--	--	--	--	--	--	--	800
33-0044		09/13/95	11:39	104	55	--	12	<2.5	0.77	<0.02	1.6	0.26	140
33-0075		10/04/95	12:27	42	14	--	10	<2.5	0.49	0.02	1.0	0.24	160
33-0092	33-0093	11/08/95	12:05	16	11	--	2.0	<2.5	0.16	<0.02	0.25	0.03	183
33-0093	33-0092	11/08/95	12:05	18	11	--	2.0	<2.5	0.11	0.02	0.25	0.04	--
33-0109	33-0110	12/06/95	14:08	21	**	--	4.0	<2.5	<0.10	<0.02	0.27	0.02	100
33-0110	33-0109	12/06/95	14:08	21	--	--	5.0	3.0	--	--	--	--	--
33-0118		02/28/96	10:53	17	**	--	5.0	9.0	<0.10	<0.02	0.27	0.03	18
33-0130		03/20/96	11:31	19	23	--	7.0	23	**	0.03	0.29	0.08	61
33-0143		04/11/96	11:14	--	8.5	--	--	--	<0.10	0.02	0.21	0.02	<2
33-0164		05/15/96	12:04	17	**	--	4.0	<2.5	<0.10	<0.02	0.14	0.02	39
33-0177		06/19/96	12:29	32	23	--	7.0	<2.5	**	<0.02	0.32	0.05	124
NORTH RIVER													
Station: NR01, Unique ID: W0023, Description: in Shelburne Falls, 150 feet north of North River Road bridge off Route 112.													
33-0032		08/30/95	9:45	--	--	--	--	--	--	--	--	--	800
EAST BRANCH NORTH RIVER													
Station: EBNR06, Unique ID: W0024, Description: in Colrain, about 700 feet upstream from bridge just north of downtown Colrain on Route 112, sampled from south bank on access road.													
33-0037		08/30/95	11:43	--	--	--	--	--	--	--	--	--	100
WEST BRANCH NORTH RIVER													
Station: WBNR05, Unique ID[2]: W0025, Description: in Colrain just upstream from bridge across from the Branch Cemetery on Adamsville Road, sampled from north bank in middle of 6 to 8 foot wide stream.													
33-0036		08/30/95	11:10	--	--	--	--	--	--	--	--	--	200

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
CLESSON BROOK													
Station: SH01, Unique ID: W0028, Description: in Ashfield, about 0.5 miles upstream from confluence with Smith Brook near Hawley Road bridge, instream above bridge.													
33-0066		09/27/95	11:46	--	--	--	--	--	--	--	--	--	<5
CLESSON BROOK													
Station: CL02, Unique ID: W0027, Description: in Buckland, approximately 200 yards downstream from Hog Hollow Road bridge off Route 112.													
33-0064		09/27/95	10:55	--	--	--	--	--	--	--	--	--	15
CLESSON BROOK													
Station: CL, Unique ID: W0026, Description: in Buckland, located at bridge on Route 112 northeast of Depot Road, off west bank just above bridge.													
33-0063		09/27/95	10:21	--	--	--	--	--	--	--	--	--	15
33-0074		10/04/95	12:03	--	--	--	--	--	--	--	--	--	265
33-0090		11/08/95	11:32	--	--	--	--	--	--	--	--	--	120
33-0108		12/06/95	13:43	--	--	--	--	--	--	--	--	--	21
33-0129		03/20/96	11:11	--	--	--	--	--	--	--	--	--	**
33-0141		04/11/96	10:43	--	--	--	--	--	--	--	--	--	20
33-0157		04/24/96	12:13	20	16	--	6.0	4.0	<0.10	<0.02	0.25	0.02	86
33-0162		05/15/96	11:29	--	--	--	--	--	--	--	--	--	35
33-0175		06/19/96	11:59	--	--	--	--	--	--	--	--	--	45
CLARK BROOK													
Station: CK, Unique ID: W0029, Description: in Buckland, located at bridge on Route 112, approximately 200 feet east of Clesson Brook, from north bank just above bridge.													
33-0091		11/08/95	11:44	--	--	--	--	--	--	--	--	--	60
33-0107		12/06/95	13:28	--	--	--	--	--	--	--	--	--	20
33-0142		04/11/96	10:55	--	--	--	--	--	--	--	--	--	31
33-0158		04/24/96	11:59	16	12	--	3.0	<2.5	<0.10	<0.02	0.07	0.01	110
33-0163		05/15/96	11:41	--	--	--	--	--	--	--	--	--	10
33-0176		06/19/96	12:11	--	--	--	--	--	--	--	--	--	298

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, – = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
SMITH BROOK													
Station: CL03, Unique ID[2]: W0030, Description: at Buckland four corners, just upstream of confluence with Clesson Brook, instream.													
33-0065		09/27/95	11:19	--	--	--	--	--	--	--	--	--	20
UPPER BRANCH													
Station: UB01, Unique ID: W0031, Description: in Ashfield above bridge on Apple Valley Road near gravel pit, instream.													
33-0067		09/27/95	12:12	--	--	--	--	--	--	--	--	--	40
MILL BROOK													
Station: MIL2, Unique ID: W0032, Description: about 300 feet above covered bridge in Charlemont, instream.													
33-0061		09/27/95	14:10	--	--	--	--	--	--	--	--	--	5
MILL BROOK													
Station: MI , Unique ID: W0033, Description: in Charlemont, located at mouth of brook within 20 feet of confluence of Deerfield River, instream.													
33-0060		09/27/95	13:49	--	--	--	--	--	--	--	--	--	135
33-0089		11/08/95	11:02	--	--	--	--	--	--	--	--	--	120
33-0106		12/06/95	13:00	--	--	--	--	--	--	--	--	--	35
33-0159		04/24/96	11:32	5.0	5.8	--	2.0	<2.5	<0.10	<0.02	0.05	0.01	4
HEATH BROOK													
Station: MIL3, Unique ID: W0034, Description: in Heath on Heath Brook approx. 2/10 mile from confluence with Mill Brook off Dell Road, instream.													
33-0062		09/27/95	14:33	--	--	--	--	--	--	--	--	--	20
BOZRAH BROOK													
Station: BO, Unique ID: W0035, Description: in Charlemont, located off South River Road near the entrance to Berkshire East Ski Area, instream, 75 feet upstream from bridge.													
33-0059		09/27/95	13:17	--	--	--	--	--	--	--	--	--	320
33-0088		11/08/95	10:48	--	--	--	--	--	--	--	--	--	40
33-0105		12/06/95	12:03	--	--	--	--	--	--	--	--	--	12
33-0155	33-0156	04/24/96	11:14	12	8.1	--	1.0	<2.5	<0.10	<0.02	0.09	<0.01	24
33-0156	33-0155	04/24/96	11:14	12	8.1	--	<1.0	<2.5	<0.10	<0.02	0.09	<0.01	--
CHICKLEY RIVER													
Station: CH5, Unique ID: W0039, Description: 100 feet downstream of Route 8A bridge in West Hawley above confluence of King Brook, instream.													
33-0056		09/27/95	11:48	--	--	--	--	--	--	--	--	--	43

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, – = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
CHICKLEY RIVER													
Station: CH4, Unique ID[2]: W0038, Description: in Hawley, due west of Forge Hill.													
33-0055		09/27/95	11:10	--	--	--	--	--	--	--	--	--	55
CHICKLEY RIVER													
Station: CH3, Unique ID: W0037, Description: just above confluence with Mill Brook, instream.													
33-0054		09/27/95	10:42	--	--	--	--	--	--	--	--	--	13
CHICKLEY RIVER													
Station: CH7, Unique ID: W0036, Description: in Hawley, across from farm just upstream from 2nd bridge on Route 8A upstream from confluence with the Deerfield.													
33-0058		09/27/95	12:29	--	--	--	--	--	--	--	--	--	**
CHICKLEY RIVER													
Station: CH, Unique ID: W0040, Description: in Charlemont located at bridge on Tower Road between Routes 2 and 8A, approximately 100 feet from Deerfield River, instream except during high flow.													
33-0043		09/13/95	10:57	--	--	--	--	--	--	--	--	--	1,920
33-0052		09/27/95	9:57	--	--	--	--	--	--	--	--	--	108
33-0073		10/04/95	11:23	--	--	--	--	--	--	--	--	--	395
33-0087		11/08/95	10:30	--	--	--	--	--	--	--	--	--	50
33-0104		12/06/95	11:48	--	--	--	--	--	--	--	--	--	10
33-0128		03/20/96	10:43	--	--	--	--	--	--	--	--	--	14
33-0140		04/11/96	10:10	--	--	--	--	--	--	--	--	--	<2
33-0154		04/24/96	10:52	6.0	5.4	--	1.0	5.0	<0.10	<0.02	0.05	0.02	16
33-0161		05/15/96	10:56	--	--	--	--	--	--	--	--	--	10
33-0174		06/19/96	11:31	--	--	--	--	--	--	--	--	--	128
MILL BROOK													
Station: CH2, Unique ID: W0041, Description: Mill Brook just above confluence with the Chickley River, instream.													
33-0053		09/27/95	10:32	--	--	--	--	--	--	--	--	--	60
KING BROOK													
Station: CH6, Unique ID: W0042, Description: in Hawley in King Brook at confluence with Chickley River.													
33-0057		09/27/95	11:57	--	--	--	--	--	--	--	--	--	5

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
COLD RIVER													
Station: CO, Unique ID[2]: W0043, Description: in Florida, located at bridge to entrance to Mohawk Trail State Forest Campgrounds off Route 2 (approximately 1.35 miles above the mouth).													
33-0042		09/13/95	10:36	--	--	--	--	--	--	--	--	--	100
33-0072		10/04/95	11:04	--	--	--	--	--	--	--	--	--	30
33-0086		11/08/95	10:13	--	--	--	--	--	--	--	--	--	141
33-0103		12/06/95	11:28	--	--	--	--	--	--	--	--	--	8
33-0127		03/20/96	10:25	--	--	--	--	--	--	--	--	--	10
33-0139		04/11/96	9:53	--	--	--	--	--	--	--	--	--	<2
33-0152		04/24/96	10:32	3.0	4.1	--	4.0	10	<0.10	<0.02	0.08	0.02	4
33-0173		06/19/96	11:07	--	--	--	--	--	--	--	--	--	<9
PELHAM BROOK													
Station: PE, Unique ID: W0044, Description: in Charlemont located at bridge off Zoar Road, just above bridge, south side, instream.													
33-0085		11/08/95	9:53	--	--	--	--	--	--	--	--	--	15
33-0102		12/06/95	11:05	--	--	--	--	--	--	--	--	--	74
33-0151		04/24/96	10:17	3.0	3.6	--	1.0	<2.5	<0.10	0.02	0.04	0.01	<4

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G5. 1995/1996 DWM Deerfield River Watershed stream discharge measurements. (All measurements made between 0930 and 1400 hours)

	Sampling Equipment	Average Velocity (fps)	Total Discharge (cfs)
GREEN RIVER			
Station: GR			
Description: in Greenfield, at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP			
09/13/95	Swoffer	0.73	6.7
11/08/95	Swoffer	3.16	342
12/06/95	Swoffer	2.26	155
02/28/96	Swoffer	2.85	377
03/20/96	Swoffer	3.05	419
04/11/96	Swoffer	2.57	247
05/16/96	Bridge Board	0.69*	385
06/19/96	Swoffer	1.41	97.6
BEAR RIVER			
Station: BE			
Description: in Conway, approximately 400 yards upstream from bridge on Shelburne Falls Road			
09/13/95	Swoffer	0.53	**
11/08/95	Swoffer	0.6	31.8
12/06/95	Swoffer	0.35	17.0
02/28/96	Swoffer	0.89	51.3
03/20/96	Swoffer	1.02	64.9
04/11/96	Swoffer	0.54	27.5
05/16/96	Swoffer	0.67	35.6
06/19/96	Swoffer	0.24	10.9

***** average depth was 7.12 feet
** censored/missing data

REFERENCES

MA DEP 1990. *BASINS PROGRAM Standard Operating Procedures River and Stream Monitoring*. Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch. Westborough, MA.

MA DEP. 1995, January Draft. *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis. Wall Experiment Station, Lawrence, MA.

MA DEP. 2000. Memorandum to Rick McVoy, Laurie Kennedy, Tom Dallaire, Arthur Johson and Mollie Weinstein from Mark Guilmain dated February 2000. *1994, 95 & 96 QA/QC Assessment Report.* CN 036.0. Division of Watershed Management Department of Environmental Protection. Worcester, MA

Socolow, R.S., L.Y. Comeau, R.G. Casey, and L.R. Ramsbey. 1996. *Water Resources Data for Massachusetts and Rhode Island, Water Year 1995.* U.S. Geological Survey Report MA-RI-95-1. U.S. Geological Survey, Water Resources Division. Marlborough, MA.

APPENDIX H
SUMMARY OF NPDES, WMA, AND FERC LICENSED FACILITIES IN THE DEERFIELD RIVER WATERSHED

Table H1. Deerfield River Watershed Industrial wastewater discharges.

Permitee	NPDES #	Issuance	Flow (MGD)	Type of Discharge	Receiving Water (Segment)
Yankee Atomic Electric Co. (YAEC), Rowe	MA0004367	7/24/2003, Prior issued: 9/1988; Closed: 2/26/1992; to be reissued 2003	0.22	Outfall 001A: auxiliary service (non-contact cooling) water, and test tank water	Sherman Reservoir (MA33018)
USGenNE Electric Co., Rowe/Florida	MA0034878	September 1997	0.07	Outfall 001: station sump water with oil flotation	Deerfield River (MA33-01)
			0.34	Outfall 002: bearing cooling water	
			0.009	Outfall 003: bearing cooling water strainer backwash	
USGenNE Electric Co., Rowe	MA0034886	September 1997	6.58	Outfall 001: equipment cooling water, floor and associated drain water	Deerfield River (MA33-01)
			0.22	Outfall 002: strainer backwash	
USGenNE Electric Co., Monroe	MA0034908	September 1997	0.05	Outfall 001A: max. Discharge of station sump water with oil separation	Deerfield River (MA33-01)
			0.02	Outfall 001B: avg. discharge of station sump water with oil separation	
USGenNE Electric Co., Florida	MA0034894	September 1997	0.072	Outfall 001A: station sump water with oil flotation	Deerfield River (MA33-01)
			0.252	Outfall 001B2: bearing cooling water	
			0.0126	Outfall 003: strainer backwash	
			<10 GPD	Outfall 004: sump water with oil flotation	
USGenNE Electric Co., Buckland	MA0034860	September 1997	0.0015	Outfall 001: floor drain water	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer cooling water	
			0.0216	Outfall 003: bearing cooling water	
USGenNE Electric Co., Buckland	MA0034851	September 1997	0.0015	Outfall 001: internal facility drainage	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer non-contact cooling water	
			0.0216	Outfall 003: bearing contact cooling water	
			0.0432	Outfall 004: cooling water strainer backwash	
USGenNE Electric Co., Florida	MA0034843	September 1997	0.0015	Outfall 001: internal facility drainage	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer non-contact cooling water	
			0.0216	Outfall 003: bearing contact cooling water	
			0.0432	Outfall 004: cooling water strainer backwash	

Table H1 (continued). Deerfield River Watershed Industrial wastewater discharges

Permitee	NPDES #	Issuance	Flow (MGD)	Type of Discharge	Receiving Water (Segment)
Consolidated Edison Energy, Buckland	MA0035670	September 1997	0.00864	Outfall 001: bearing cooling water	Deerfield River, No. 3 canal in Buckland (MA33-03)
			10 GPD	Outfall 002: boiler blowdown	
WTE Recycling, Greenfield	MAR05B674	February 2001	NA	Stormwater discharge	Deerfield River (MA33-04)
BBA Nonwovens Simpsonville, Inc, Ashfield	MA0003697	March 2001	1.35	Industrial and domestic wastewater	North River (MA33-06)
BBA Nonwovens Simpsonville, Inc, Ashfield	MAR05B746	January 2001	NA	Stormwater discharge; permit requires development of a SWPPP (Storm Water Pollution Prevention Plan).	North River (MA33-06)

Table H2. Deerfield River Watershed sanitary wastewater discharges.

Permitee	NPDES #	Issuance	Flow (MGD)	Receiving Water (Segment)
Monroe WWTP, Monroe	MA0100188	October 1998	0.015	Deerfield River (MA33-01)
Charlemont WWTP, Charlemont	MA0103101	September 1997	0.05	Deerfield River (MA33-02)
Shelburne Falls WWTP, Buckland	MA0101044	September 1997	0.25	Deerfield River (MA33-03)
Old Deerfield WWTP, Deerfield	MA0101940	September 1997	0.25	Deerfield River (MA33-03)
Greenfield WPCP, Greenfield	MA0101214	October 2002	3.2	Deerfield River (MA33-04)

Table H3. Deerfield River Watershed FERC Projects.

Project Name	Project Number	Owner Name / Issuance date	Receiving Water (Segment)	Kilowatts
Deerfield No.5	2323D	USGenNE / 4 April 1997	Deerfield River (MA33-01)	17,550
Fife Brook	2669A	USGenNE / 4 April 1997	Deerfield River (MA33-01)	4,800
Bear Swamp	2669B	USGenNE / 4 April 1997	Deerfield River (MA33-01)	610,000
Sherman	2323E	USGenNE / 4 April 1997	Deerfield River (MA33-01)	7,200
Deerfield No.4	2323C	USGenNE / 4 April 1997	Deerfield River (MA33-02)	4,800
Deerfield No. 2	2323A	USGenNE / 4 April 1997	Deerfield River (MA33-03)	4,800
Deerfield No.3	2323B	USGenNE / 4 April 1997	Deerfield River (MA33-03)	4,800
Gardners Falls	2334A	ConEdison Energy / 4 April 1997	Deerfield River (MA33-03)	3,580

Table H4. List of WMA registered and permitted average annual water withdrawals in the Deerfield River Watershed (LeVangie 2003. Water management Act Database. Massachusetts Department of Environmental Protection, Bureau of resource Protection, Database Manager. Boston, MA.).

Permit	Registration	PWSID	System Name	Registered Volume (MGD)	Source	G or S	Well/Source Name	Withdrawal Location (Segment)
	10302901	1029000	Bernardston Fire & Water District	0.17	029-02	G	Gravel Dug Well #2	Bernardston (MA33-30)
					1029000-01	G	Dug Well	Bernardston(MA33-30)
	10306601		BBA Nonwovens	0.89	01	S	North river	Colrain (MA33-06)
	10307401	1074000	Deerfield Fire District	0.1	074-02	G	Keats Spring	Deerfield (MA33-03)
					074-03*	G	Wells Spring	Deerfield (MA34-04)
					074-01	G	GP Well Rt. 5-Wapping Well	Deerfield (MA33-03)
					074-06	G	Stillwater Springs	Deerfield (MA33-03)
					074-04	G	Harris Springs	Deerfield (MA33-03)
					074-05	G	Stillwater Well	Deerfield (MA33-03)
	10307402		Williams Farm, Inc.	0.08	01	S	Williams Farm #1	Franklin (MA33-03)
					02	S	William Farm #2	Deerfield (MA33-03)
					03	S	Williams Farm #3	Deerfield (MA33-03)
					04	S	Williams Farm #4	Deerfield (MA33-03)
	10307403		Savage Farms, Inc.	0.29	01	S	Savage Farm-Deerfield 1	West Deerfield (MA33-03)
					02	S	Savage Farm-Deerfield 2	West Deerfield (MA33-03)
					03	S	Savage Farm-Deerfield 3	West Deerfield (MA33-03)
					04	S	Savage Farm-Deerfield 4	West Deerfield (MA33-03)
	10311401	1114000	Greenfield Water Department	2.12	114-04	G	Millbrook Well #1	Greenfield (MA33-30)
					114-01	S	Glen Brook-Upper Reservoir	Leyden (MA33-29)
					114-06	G	Millbrook Well #3	Greenfield (MA33-30)
					114-05	G	Millbrook Well #2	Greenfield (MA33-30)
					114-03	S	Green River	Greenfield (MA33-28)
9P10326801	10326801	1268000	Shelburne Falls Fire District	0.21	268-01	S	Fox Brook Reservoir	Colrain (MA33-06)
					268-02	G	Well #2	Colrain (MA33-06)
					268-01	G	Well #1(abandoned)	Colrain (MA33-06)
					268-03	G	Well #1 Replacement	Colrain (MA33-06)
	10307404		Trew Corporation	0.14	03	G	Trew Corp Well	Deerfield (MA33-04)

*****this source (Wells Spring-03G) is located in the Connecticut River Watershed (segment MA34-04), G – ground water, S – surface water

APPENDIX I
STATE AND FEDERAL WATER QUALITY RELATED GRANT AND LOAN PROJECTS IN THE DEERFIELD WATERSHED

MASSACHSUETTS WATERSHED INITIATIVE

The Massachusetts Watershed Initiative (MWI) was active during the years of 1998-2003. During those years, EOEA Watershed Team Leaders, in conjunction with State and Federal agencies, municipal governments and regional planning agencies, universities, local watershed associations, businesses and other groups, developed work plans that identified the most important goals for each watershed and the specific projects and programs which were needed to meet those goals. Projects funded under the MWI include hydrologic and water quality monitoring and assessment, habitat assessment, non-point source assessment, hydrologic modeling, open space and growth planning, and technical assistance and outreach. MWI funded projects in the Deerfield Watershed related to water quality include:

- MWI Deerfield Workplan Project FY99: ***DRWA Volunteer Monitoring Support*** for the Deerfield River Watershed Association to purchase monitoring equipment and supplies to help expand their volunteer water quality monitoring capacity. Cost: $3,000 (EOEA)
- MWI Volunteer Monitoring Grants FY99: ***Volunteer Wetland Monitoring Project in the Deerfield River Watershed*** conducted by the Green River Watershed Preservation Alliance (GRWPA) during the spring of 1999 to monitor 22 marshes for calling amphibians and marsh birds. Goals of this project (which was continued for 2000 and 2001under different funding) included expanding current monitoring efforts in the Deerfield watershed and to identify biologically significant wetlands that support rare species and/or a high number of species. Cost: $5,000 (EOEA)
- MWI Deerfield Workplan Project FY99: ***Installation of Agricultural BMPs*** to protect water quality on selected farms in the watershed. BMPs installed included agrichemical mixing facilities, cattle/tractor access road to protect wetlands, and streamside fencing. Cost: $20,626 (DFA Agriculture Enhancement Program), $1,500 (USFW Partners for Wildlife Program)
- MWI Deerfield Workplan Project FY00: ***Water Quality Monitoring of the Deerfield Watershed*** conducted by Environmental Science Services, Inc. in 2000 as part of comprehensive water quality assessment monitoring being conducted in the watershed during "year two". A QAPP was prepared and water samples were collected for bacteria analysis and meter parameters to augment and compliment the MA DEP/DWM water quality sampling plan in the watershed. Sediments were also collected from behind dams on the mainstem Deerfield River and were analyzed for heavy metals and organics to investigate potential impacts from current and historic landuses along the mainstem. Cost: 49,500 (EOEA)
- MWI Deerfield Workplan Project FY00-FY02: ***ACOE Stream Ecosystem Restoration Feasibility Study*** conducted in 2000 – 2004 by the Army Corps of Engineers to investigate potential stream ecosystem restoration projects on the Green River in Greenfield. Study included hydrologic, sediment, biologic, and historic evaluation of the river that is impounded by four dams within the City of Greenfield. The study concentrated on the feasibility of improving the aquatic habitat including dam removal and installation of fish passage structures. Total Project Cost: $462,000; Cost Share: $180,000 (EOEA); $51,000 (City of Greenfield); $231,000 (ACOE)
- MWI Deerfield Workplan Project FY01-FY02: ***DEP/WERO Wetlands Circuit Rider Position (Greater Connecticut Watershed Regional Project)*** to support the funding of a full time wetlands circuit rider at MA DEP Western Regional Office for two years. The Circuit Rider provided technical assistance and outreach to municipalities in the Western Region, including all towns in the Deerfield Watershed, on local implementation and enforcement of the Wetlands Protection Act. Cost (two years): $85,500 (MA DEP)
- MWI Project 02-07/MWI: ***Deerfield River Watershed Municipal Landfill Assessment*** conducted in 2002 – 2003 by Fuss and O'Neill, Inc. to identify and list all historic and current municipal and industrial landfill sites. Project described each landfill based on its proximity to sensitive receptors, mapped the location of all landfill sites on GIS using GPS technology, and developed GIS maps that included hydrology, critical habitats, local and major roadways, water supplies, public recreation sites, topography, and surficial geology. This information was used to prioritize and rank landfill sites according to potential risk for contamination and identify eight of the most sensitive sites to conduct field reconnaissance and screening level sampling to further evaluate the potential for contamination. Project Cost: $38,000 (MA DEP)

- MWI Deerfield Workplan Project FY03: ***Japanese Knotweed Inventory and Removal*** conducted in 2003 by the DRWA used volunteers to inventory and map stands of the invasive plant, Japanese knotweed along selected tributaries in the Deerfield Watershed. Funding for the entire project was cut when the Watershed Initiative was ended and only inventory portion of the project was performed, so the DRWA plans to look for alternative funding to perform proposed removal activities. Cost: $9,604 (DCR)
- MWI Deerfield Workplan Project FY03: ***Watershed Assessment Report and Watershed Action Plan for the Deerfield Watershed*** began in 2003 and is being conducted by Gomez and Sullivan, Inc. to prepare a detailed assessment of the current environmental conditions in the watershed, evaluate potential causes of impairment to environmental resources, and recommend goals, objectives, and specific action items to mitigate priority problems and protect priority resources. Cost: $25,000 (EOEA)

MASSACHUSETTS ENVIRONMENTAL TRUST

The Massachusetts Environmental Trust (MET) is an office within the Executive Office of Environmental Affairs that protects and preserves the Commonwealth's water resources and their ecosystems through its grant making programs. The Trust's ability to support critical environmental initiatives throughout Massachusetts comes from the sale of special environmental license plates and the proceeds from environmental litigation settlements. The Trust is dedicated to promoting proactive environmental stewardship, environmental awareness, and the protection of our state's water-related resources through annual competitive grants to local, regional and statewide non-profit organizations, educational institutions, and government agencies. MET Grants in the Deerfield Watershed are:

- MET FY 2001 General Grants Program: ***Deerfield River Watershed Association Volunteer Wetland Monitoring Project*** to continue volunteer surveys of selected marshes in the Deerfield Watershed for calling amphibians and selected waterbirds in order to collect baseline data on wetland wildlife communities, increase public awareness, and increase the level of protection for these resources. Grant Amount: $14,875
- MET FY 2002 Environmental Monitoring Grants Program: ***Deerfield River Watershed Association Volunteer Monitoring Program Support*** to establish a water quality laboratory in the watershed to increase the capacity and viability of their volunteer water quality monitoring program. Grant Amount: $4,000

SECTION 319 NONPOINT SOURCE GRANT PROGRAM

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. Section 319 is administered by the U.S. Environmental Protection Agency (EPA), which oversees the awards to individual states. The MA DEP Bureau of Resource Protection administers this award as part of the Massachusetts Nonpoint Source Program. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan.

- There were no Section 319 funded projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

SECTION 604(B) WATER QUALITY PLANNING GRANT PROGRAM

This Grant Program is authorized under Section 604(b) of the Federal Clean Water Act and funds are awarded to individual states through the U.S. EPA. In Massachusetts the 604(b) Program is administered by the MA DEP, Bureau of Resource Protection. The program is designed to assist eligible recipients in providing water quality assessment and planning assistance to local communities. Priority is given to projects that provide diagnostic information to support the MA DEP's watershed management activities and to projects located in one of the priority watersheds targeted for assessment work by the MA DEP. 604(b) projects conducted in the Deerfield Watershed are:

- Section 604(b) Project 97-01/604 – ***Stream Classification and Assessment Project*** conducted by the Franklin Regional Council of Governments in the Connecticut and Deerfield Watersheds to classify and assess stream types using the Rosgen Stream Classification Method. Goals of the project were to use the information to make predictions about stream behavior and anticipate problems in the watershed as a result of certain land uses, identify areas in need of restoration, distinguish between natural stream migration and evidence of stream instability, and improve overall ability to make good watershed planning decisions based on the stability and types of streams in the watershed. Grant Amount: $52,500 (EPA)

104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM

This Grant Program is authorized under Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. Grant funds under the 104(b)(3) program are made available to Massachusetts agencies under the National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency. These grants, administered by the MA DEP, Bureau of Resource Protection,.provide a results oriented approach that focuses attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are: 1) ensure safe drinking water; 2) reduce, eliminate and/or control point and non-point source pollution; 3) protect wetland quality and function and ensure no-net-loss of wetlands; 4) reduce and reverse acidification of water bodies.

- 99-06/104 *Lake Surveys for TMDL Development*. The objective for this statewide study is to provide a database for lakes listed as impaired on the 303(d) List. Data such as secchi, bathymetry, nutrients, aquatic plant species composition and plant coverage will be compiled to determine optimal plant coverage for fisheries. Additionally, MA DFWELE will provide technical assistance and transfer of fisheries data to government agencies and private organizations involved in watershed management and assist in the development of volunteer and watershed participant action plans. Two ponds in the Deerfield River Watershed, Pelham Lake and Plainfield Pond, were sampled as part of this project in 2000.

RESEARCH AND DEMONSTRATION GRANT PROGRAM

The Research and Demonstration Program (R&D) is authorized by section 38 of Chapter 21 of the Massachusetts General Laws and is funded by proceeds from the sale of Massachusetts bonds. It is administered by the MA DEP, Bureau of Resource Protection. Specifically, the R&D Program was established to enable the Department to conduct a program of study and research and demonstration relating to water pollution control and other scientific and engineering studies "...so as to insure cleaner waters in the coastal waters, rivers, streams, lakes and ponds of the Commonwealth."

- There were no R&D projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program was developed in support of the 1996 Safe Drinking Water Act Amendments and the MA DEP's Source Water Assessment Program. Funding is provided from the Drinking Water State Revolving Fund and is available to public water systems for developing and implementing wellhead protection projects and plans. Wellhead Protection Grant Program projects in the Deerfield River Watershed are:

- 99-07/WHP: ***Ashfield Wellhead Protection Project.*** This project has installed an insulated shelter for the wellhead and a barrier to protect the District's only drinking water source from an adjacent road; installed lightning arresters that protect the water supply from strikes that have interrupted service in the past.
- 99-10/WHP: ***Shelburne Falls Wellhead Protection Project****.* This project is designed to help protect the water supply through public education and proposed wellhead protection bylaws and regulations; work with area governments and schools to raise the awareness of the potential for contamination and for the need to establish Board of Health regulations and town by-laws to protect water sources; and update an out-of-date land use survey and emergency response plan.

- 99-12/WHP: ***Griswoldville Wellhead Protection Project.*** This project will install watertight/flood tight manhole covers in the IWPA; install a chainlink fence and wellhead protection signs; and issue public service announcements for consumers and local town officials on the need to protect the District's well.
- 00-05/WHP: ***Shelburne Falls Wellhead Protection Project – Phase II.*** This project will initiate a K-12 education curriculum; support the adoption of a Board of Health floor drain regulation; develop a Hazardous Materials Storage and Floor Drain Inspection Program; and repair two of the wellhouse's brick walls that leak and allow for stormwater flooding.
- 00-13/WHP: ***Sanderson Academy Wellhead Protection Project.*** This project will install security fencing and a pumphouse to protect the Sanderson Academy's sole source water supply from unauthorized access, improve design of the facility, and develop educational curricula on source protection.
- 01-01/WHP: ***Florida Wellhead Protection Project.*** This project will construct a new containment building outside the Zone I for the Abbott Memorial School in the Town of Florida. This project will eliminate the threat of contamination to the school's water supply and incorporate student participation and education.

SOURCE WATER PROTECTION TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program, administered by MA DEP, was developed in support of the 1996 Safe Drinking Water Act Amendments and the MA DEP's Source Water Assessment Program. Funding is provided from the Safe Drinking Water Revolving Fund and is available to public water suppliers and third party technical assistance organizations to assist public water suppliers in protecting local and regional ground and surface drinking water supplies. Source Water Protection Grant Projects in the Deerfield Watershed are:

- 02-06/SWT: ***Greenfield Source Water Protection Project.*** This project, being conducted by Tighe & Bond, Inc., will fund a storm drainage study, a survey of underground storage tanks, and a public education program for the City of Greenfield's Leyden Glen Reservoir.

CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. This program assists cities, towns, and wastewater districts in the financing of water pollution abatement projects, including nonpoint source projects. The financial assistance takes the form of subsidized loans at a 2% interest rate to borrowers. The SRF Program is jointly administered by the Division of Municipal Services of the MA DEP and the Massachusetts Water Pollution Abatement Trust. The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed.

- There were no SRF projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

MASSACHUSETTS DRINKING WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts Drinking Water State Revolving Fund (DWSRF) provides low-cost financing to help community public water suppliers comply with federal and state drinking water requirements. The DWSRF Program's goals are to protect public health and strengthen compliance with drinking water requirements, while addressing the Commonwealth's drinking water needs. The Program incorporates affordability and watershed management priorities. The DWSRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection and the Massachusetts Water Pollution Abatement Trust (Trust). The current subsidy level is equivalent to a 50% grant, which approximates a two percent interest loan. The Program will initially operate with approximately $50 million in financing capacity. For calendar years 1999 through 2003, up to $400 million may be available through the loan program. Drinking Water State Revolving Loan Projects in the Deerfield Watershed are:

- 99-15/SRF: ***Ashfield Water District System Improvement Project.*** This project provides for the construction of a covered storage/pump station/operations facility; replacement of a portion of the distribution system; corrosion control; removal of a surface water source and an upgrade of a ground water source. All of this is being undertaken to achieve compliance with the Safe Drinking Water Act, especially the Surface Water Treatment Rule.

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems. The law appropriated $30 million to the MA DEP to assist homeowners. The Department uses the appropriation to fund loans through the Massachusetts Water Pollution Abatement Trust. The fund provides a permanent state/local administered revolving fund to assist income-eligible homeowners in financing necessary Title 5 repairs. Working together, the MA DEP and the Trust have created the Community Septic Management Program to help Massachusetts' communities protect threatened ground and surface waters while making it easier to comply with Title 5. This loan program offers three options from which a local governmental unit can choose.

- Currently two Deerfield Watershed municipalities, Greenfield and Leyden, are involved with the Community Septic Management Program.

DEPARTMENT OF CONSERVATION AND RECREATION (DCR) LAKES AND PONDS GRANT PROGRAM

The Department of Conservation and Recreation, (formerly DEM) Lakes and Ponds Grant Program assists municipalities and local organizations that are striving to meet the challenges of long term lake and pond management by awarding grants for the protection, preservation and enhancement of public lakes and ponds in the Commonwealth. A maximum grant of $25,000 per project is available to eligible applicants on a 50/50 cost-sharing basis. Grant applicants must be municipalities, local commissions, local authorities or lake districts. DCR's Lake and Pond grant program awards grants for the protection, preservation and enhancement of public lakes and ponds in the Commonwealth. A key goal of the program is to promote a holistic approach to lake management, which is based on sound scientific principles and emphasizes the integrated use of watershed management, in-lake management, pollution prevention and education to provide long-term solutions to lake problems.

- 1997 Lakes and Ponds Grant - to the Town of Greenfield for the **Highland Pond Management Project**. Study of Highland Pond that included a watershed analysis, water quality testing, hydrologic assessment, and pond bottom and sediment assessment as well as recommendations for lake management to protect the recreational value of the pond. Grant Amount: $3,250.
- 1999 Lakes and Ponds Grant to the Town of Greenfield for phase II of the **Highland Pond Management Project**. Project involved preparation of a preliminary dredging plan for Highland Pond. Grant Amount: $4,000.

DEPARTMENT OF FISH AND GAME, RIVERWAYS SMALL GRANTS PROGRAM

Initiated in 1987, the Riverways Small Grants Program provides modest amounts of money to promote the restoration and protection of the ecological integrity of Commonwealth's rivers, streams, and adjacent lands. The grants foster action and result in benefits to the community that continue well after the grant period ends, as well as leverage local and foundation funding. In addition to providing seed money, Riverways also offer technical assistance, as appropriate, to both groups receiving grant awards and those that do not. The Riverways Programs, Department of Fish and Game, solicits project proposals for Small Grants from municipal governments and non-profit organizations for projects to be implemented by June 30, each year. Riverways Small Grant Projects in the Deerfield Watershed are:

- Small Grants FY 2000: **Deerfield River Watershed Association Volunteer Wetland Monitoring Project** to hire a project manager to train volunteers who surveyed riparian wetlands and "called" for amphibians and selected waterbirds to establish what species are dependent on these marshes. Grant Amount: $5,000
- Small Grants FY 2002: **Deerfield/Millers Chapter of Trout Unlimited** to hire a coordinator to work with participating schools in the already established Atlantic Salmon Egg Rearing Project. Goals of this project are to help protect salmon in the early years of life in fresh water habitat by increasing local knowledge of salmon restoration efforts, inspiring watershed stewardship among students in the community, and increasing the volunteer base for salmon fry stocking in the spring. Grant Amount: $5,000